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BULLETIN OF THE ATOMIC SCIENTISTS

Founded in 1945 by Hyman H. Goldsmith and Eugene Rabinowitch

Vol. VIII **June 1952** **No. 5**

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Published monthly by the Educational Foundation for Nuclear Science, Inc., 956 E. 58th Street, Chicago 37. Phone: MIdway 3-3056. Manuscripts should be sent in duplicate to the Managing Editor at the above address. Publication date: 15th of the month. Subscription and advertising service: All correspondence in regard to changes of address, new subscriptions, and advertising rates, should be sent to 53 W. Jackson Blvd., Chicago 4, Ill. Subscription—$5.00 a year. Single copy—50 cents. Four weeks notice is required for change of address: both old and new addresses must be given. Entered as second class matter at the Post Office at Chicago, Illinois, under the act of March 3, 1879. The opinions expressed in the "Bulletin" do not represent the official views of any organization.

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Biological Warfare

The recent Soviet accusation that the U.N. forces have used biological weapons in Korea has called forth the following two statements from groups of American scientists. The first, asking the United States to clarify its position on its biological warfare program, was adopted by the Council of the Federation of American Scientists at its annual meeting on May 4. The second statement, released by the American Committee for Cultural Freedom[1] on May 5, is a letter addressed to Professor Joliot-Curie by nine Nobel Prize-winning scientists, in which they urge that he withdraw his name from a Prague message supporting the Communists' charge.

FAS Asks Clarification of U.S. Policies on Germ Warfare

A NEW and clearer official statement on the extent and purposes of the U.S. biological warfare program is urgently needed to combat the effects of recent Soviet charges of use of B.W. weapons by U.N. forces in Korea. In our judgment, the scanty available evidence offered in support of these charges fails completely to substantiate them. U.S. representatives have acted wisely in seeking to obtain impartial on-the-spot investigation of all the facts, and we urge that their efforts be continued until an objective investigative agency satisfactory to both sides is found.

We wish to point out, however, that the effects of the Soviet charges are not wholly dependent upon their accuracy, and that a denial in the specific instance does not fully counter the attack. The question raised in the world's mind is not so much whether we did *use* BW in Korea, but whether we are in fact *prepared* and *willing* to use it in the future. The question is given point by U.S. official statements that we are developing BW weapons and recent reports that the Defense Department is seeking funds for expansion of its BW program, possibly including mass production of actual BW agents.

It is important to realize that the threat and horror of planned spread of disease is felt very much more keenly outside the U.S. than within it. Because BW is not known to have been tested under field conditions, and has been cloaked in extreme secrecy, assessment of its actual potential is exceedingly difficult. But the threat certainly seems less in countries like the U.S., where public health standards are high. Protected by public health barriers, most Americans have never experienced, or only dimly remember, the paralyzing fear induced by an uncontrolled epidemic. Only occasionally and in local areas have we seen the violent human emotions which arise when people are confronted with a mysteriously spreading fatal malady.

In contrast, the massed millions of the Near and Far East live in constant dread of the next disruption of the delicate equilibrium between human resistance and the virulence of disease germs. Here the effects of disease are immediate and concrete in terms of death, wasted crops, and imminent famine. Anyone who would deliberately further the spread of disease is in league with evil, feared, and little understood forces. It is upon the minds of these people that the Soviet charges fall most heavily. To them no good can be attributed to anyone willing to employ such means to gain his ends. Unfortunately, the memory of Hiroshima and Nagasaki half prepares them to assume our willingness.

It is not enough, therefore, to counter the Soviet charge with a denial and a demonstration of the inconclusiveness of the evidence offered in Korea. The charge must be countered in substance as well as in fact. A statement at the highest level—involving the President, the Secretaries of State and Defense, and the Joint Chiefs of Staff—clearly is called for. The statement must explicitly define U.S. intentions with respect to biological warfare. The policies enunciated must be based on a full-scale evaluation by civilian authorities of political as well as military implications.

We urge that this statement, as a minimum, emphasize that the U.S. government is willing and anxious to conclude with other governments an agreement formally repudiating any use of biological warfare under arrangements ensuring that the repudiation will be effective.

We make this recommendation with full recognition of the frustration of previous and present efforts along similar lines. We are aware of the difficulties involved both in reaching agreement and in making agreement effective. We recognize and emphasize too that guaranteed elimination of biological warfare is inseparable from the general problem of the intensifying armaments race, and this, in turn, is inseparable from solutions to the political issues which divide the world. We urge that U.S. efforts to gain agreement on all of these fronts be continued and expanded. Pending success on these larger objectives, we ask that U.S. policies in the limited area of biological warfare be made crystal clear so as to remove any doubt that, should war be forced upon them, the American people have no intention of introducing biological weapons into the world's already terrifying arsenal.

[1] An organization of scientists, writers, scholars, artists, and musicians dedicated to the defense of freedom of the arts and sciences. The Committee is the American affiliate of the Congress for Cultural Freedom.

Nine Nobel Prize-Winners Address Joliot-Curie

May 2, 1952

DEAR M. JOLIOT-CURIE:

We are gravely concerned over a message which was recently released under your signature from Prague. In this message you appear to give credence to reports from Communist China accusing the U.N. forces in Korea of waging germ warfare.

We, too, have seen such reports in the daily press. These reports, all of them from communist sources, embody charges of the gravest and most disturbing character: grave, because such charges cannot and must not be made lightly; and disturbing because, if untrue, they mark another attempt by the Communists to infuse fear and hatred into a world that so desperately needs brotherhood and peace.

Thus, we must ask ourselves—how true are these reports? As a scientist and Nobel Prize-winner yourself, you will agree that it is our duty—not only as scientists but as moral men—to ask this question. As scientists, we share the tradition of perpetual and uncompromising search for truth. We are trained to doubt what is unproven and to submit every claim—factual or theoretical—to the most rigorous of tests. Finally, as moral men—as human beings—it is our duty to confront the results of such tests—whatever they may be—with courage and honor, and to give the truths that result from such tests the widest possible currency.

But, as you well know, it has been most difficult so far, if indeed not impossible, to obtain information regarding germ warfare charges which would permit a careful weighing of the evidence. Such evidence, we submit, is of crucial importance in reaching a conclusion on a matter that cannot but affect the deepest emotions of peoples throughout the world. And because of this, we are unable to understand why the Chinese Communist authorities, if they really believed in the truth of their charges, did not immediately respond to an offer of the International Red Cross to carry out a careful investigation on the scene of the reported epidemics.

Our misgivings were further increased by the fact that official communist radio stations have alternated between reports of serious epidemics and denials that such epidemics exist. Equally suspicious was the allegation of the Soviet Union's spokesman at the United Nations, Mr. Joseph Malik, that the International Red Cross is not qualified to investigate the truth of the germ warfare charges. And, as if to compound our suspicions, Mr. Malik then asked us to believe that an obscure and highly partisan body of jurists is capable of conducting scientific investigations, and of reporting objectively on matters of fact. This—either as scientists or as moral men—we are unable to accept.

In the light of this, we believe it is imperative that the Peiping authorities permit the entry of International Red Cross inspection teams into China and adjacent Korea—and also that they permit the entry of epidemic control teams offered by the World Health Organization—if such epidemics do, in fact, exist. This special agency of the United Nations has established a notable record of successful emergency operations in distress areas. By first refusing to permit entry to the International Red Cross, and then by rejecting the aid offered by the World Health Organization, the communist authorities, in Peiping and Moscow, have only confirmed existing skepticism of the germ warfare charges.

Many of us have inevitably asked: What are the real motives for this seemingly well-coordinated propaganda campaign?

You, Joliot-Curie, have now given the use of your name—or permitted it to be used—in support of these unverified charges. In so doing, you have incurred a grave responsibility, a responsibility to your fellow-scientists throughout the world; and beyond that, to science itself and the truth which science must serve.

And so we ask you to accept your responsibilities. We ask you to withdraw your signature from the message recently issued at Prague. We ask you to raise your voice with ours in demanding that the germ warfare charges be put to the acid test by investigation teams of the International Red Cross or any other recognized impartial body.

In all good faith, we say: Associate yourself with us in this vitally important task, so that, together, we may establish the truth and make it known to all men.

Sincerely yours,

CARL F. CORI—Nobel Prize in Medicine & Physiology, 1947
GERTI T. CORI—Nobel Prize in Medicine & Physiology, 1947
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GEORGE H. WHIPPLE—Nobel Prize in Medicine, 1934

The Hyman Goldsmith Award

The Hyman Goldsmith Memorial Award is offered again this year for the article, book, or public pronouncement, made or published during the year 1952, which contributes most to the "clarification of the right relations between science and politics."

Readers are invited to send nominations to the Committee of Award, *care of* the *Bulletin of the Atomic Scientists,* before December 31, 1952.

This prize of $200 is given annually in memory of one of the founders of the *Bulletin,* who died in August 1949.

NO MAY BULLETIN

The *Bulletin* ordinarily combines two issues into one each summer, when its academic contributors, like its academic readers, are away from their usual pursuits.

This issue you are reading, larger than usual, is the May-June issue.

In accordance with postal regulations, this issue is numbered No. 5, rather than Nos. 5-6.

The New Working Paper and U. S. Atomic Policy

By DAVID R. INGLIS

How realistic are the new U.S. proposals for a world arms census, and does the emphasis on "inspection" in the plan indicate a possible change of U.S. policy on the techniques necessary for effective control of atomic energy? These are the questions Mr. Inglis discusses in this appraisal of the working paper which the United States recently submitted to the U.N. Disarmament Commission and which is printed in full on pages 135–38 of this issue. Mr. Inglis, a member of the staff of the Argonne National Laboratory, is the author of two articles on the atomic control problem which appeared in the October 1951 and March 1952 issues of the Bulletin.

THE new U.S. arms count proposal reproduced in this issue marks another step in the long series of negotiations on the control of atomic armaments, now appropriately combined with other arms and armed forces. Its explicit provisions bring no sudden change in the course of the negotiations, for its main outlines were dictated by the instructions to the U.N. Disarmament Commission in the resolution introduced by the U.S., Britain, and France and passed at Paris last fall by a large majority, with the usual regrettable dissenting vote. In the language of the proposal one may find implications of a departure of U.S. policy from the control mechanism of the Baruch proposal, as we shall discuss further below.

The instructions called for formulation of plans for the limitation and progressive reduction of all types of armaments, with an arms count as a first and indispensable step. This is sufficiently general to include all the practical possibilities, and makes good sense. The new proposal outlines the arms count in further detail. For those of us who believe that fate hangs in the balance and there is no time to lose before coming to some agreement to stop the atomic arms race, the step marked by the new proposal is, in a detailed sense, a step backward. The resolution instructed the Commission (in paragraph 5) "to consider from the outset *plans* for the progressive and continuing disclosure and verification, the *implementation of which* is recognized as a first and indispensable step in carrying out the disarmament program. . . ." It did not explicitly say that the complete arms count should be agreed upon in advance of the negotiations on limitation. The new proposal does, as was made clear by Mr. Cohen in presenting it; and this, standing alone, is unnecessarily unrealistic.

There are various degrees of being unrealistic. If, as is claimed by some fatalists who are resigned to whatever consequences the unbridled atomic arms race may bring, it is unrealistic to work toward and hope for atomic control, it seems unrealistic in a much higher degree to propose seriously that the nations agree to unveil all their atomic and other military secrets before starting to formulate the control plans from which tangible benefits would begin to accrue. The saving grace of the proposal in this respect is that it is submitted as a working paper, with constructive criticism and suggested change invited. This is the spirit of effective negotiation, and it is to be hoped that it may continue and prove contagious.

As a tentative plan, subject to change and to combination with further plans, the new proposal serves a very definite purpose: it opens detailed discussion on some of the difficult realities that have to be faced. It provides official recognition of the profound change that has come about, since the writing of the Baruch plan, with the development of large and competing stockpiles of atomic explosives. It is no longer enough to agree how to control production; it is necessary at the start to account at least approximately for past production. The sooner this can be done, the smaller will be the inevitable uncertainty, and the more nearly certain will be the guarantees that can be provided in an eventually complete control plan.[1] For this reason immediate implementation of the proposal essentially as submitted in outline, but with the necessary further details filled in, would be a wonderful boon to generations yet unborn (as well as to those already about). There seems to be little doubt, though it is still a matter of faith, that, if enough good will could be found for this agreement, the tapering off or cessation of production and eventual reduction of stockpiles could be expected to follow in subsequent agreements. But the good will for the initial agreement is the unrealistic hope, with international faith at such a low ebb.

Incentives for Disclosure

Incentives to make it seem to both sides more immediately worth while to agree to the provisions of the arms count proposal could be found in some sort of arms limitation or control plan. This might fall far short of the ideal of complete disarmament, or be intended to approach this ideal only after a considerable lapse of time; it

[1] *See* D. F. Cavers, "An Interim Plan for International Control of Atomic Energy." *Bulletin* VI (Jan. 1950), 13; "Atomic Controls in Disarmament Planning," *ibid.*, VIII (March 1952), 84.

could still include in its early stages tangible benefits in the limitation of the growing atomic threats. It is conceivable that these tangible benefits of "regulation, limitation, and balanced reduction" could be arranged in stages simultaneous with some of the stages of disclosure and verification, even starting with the first, thus minimizing the amount of mutual trust prerequisite to agreement (surely a desirable goal in devising further proposals).

For example, Stage 2 of the arms count proposal, which is to reveal details of mines, metallurgical installations, and the like, could be followed immediately by Stage 1 of a limitations scheme which would include cessation or slowing down of mining and metallurgical operations, as a beginning of a general tapering off of atomic production. This could proceed simultaneously with Stage 3 of the arms count proposal, which reveals the details of the plants producing fissionable materials, which could, in turn, be followed by a tapering off of these plants according to some previously agreed-upon formula, as Stage 2 of the limitations scheme. The formula might even contain parameters to be determined by Stage 3 of the arms count. It might, for example, be agreed in the initial treaties that the nation with the greater production facilities would cut down production more drastically than the other(s) at first, how much more drastically being determined by the discrepancy in production facilities revealed in Stage 3 of the arms count. Thus it is not necessarily true that the detailed mechanism of a limitations or control scheme cannot be reasonably agreed upon before the information to be revealed by an arms count is available, although this seems to be the assumption behind the submission of the arms count proposal in its present form.

Combine Control with Count

Even if this intermeshing of the stages of the arms count and of the limitation plan could not be agreed upon, it would help the prospects of agreement to combine the arms count provisions with a limitations plan, the two to be wrapped up in the same package of treaties and agreed upon at the same time, though one would go into effect later than the other. Then one could at least see what he is buying with his concessions to let in inspectors.

The disadvantage of this, compared with the intermeshed stages, is that the dissident or recalcitrant nation can then object that the others can gain information from his concessions long before he gains tangible benefits, and that they can withdraw from the plan after the first few stages. Such an objection was indeed very promptly (and thus perhaps superficially) raised to the arms count proposal of April 5. The proposal does contain an escape clause which provides that failure to comply at any stage on the part of one nation justifies the withdrawal of the others. This is probably a necessary feature of any stage-by-stage agreement, in keeping with the realistic assumption that an agreement will be honored only as long as it remains in the interest of each nation to do so. Even the Baruch plan, with its nearly idealized control scheme involving ownership of production facilities by an international atomic development authority was designed only to give adequate warning if one nation should suddenly take desperate action and start an atomic arms race.

Halting the Arms Race

Now the more urgent problem is to stop an atomic arms race already in progress. In comparison with the almost certainly catastrophic consequences of allowing it to continue forever unchecked, it is and should remain in the interest of each nation concerned that it be halted and the stockpiles brought under control. Probably the only real hope for atomic control is that through negotiation or otherwise a complete plan for atomic limitations and eventual complete control can be put in such a mutually advantageous form as to make this fundamental fact clear to all.

At present there is apparently a great disparity between the knowledge that the two opposing nations in the atomic arms race have of one another's atomic programs. Largely because of the tradition of openness inherent in our fundamental democratic convictions (of which more than a trace is still left!) and the tradition of despotism within the isolated vastness of Russia, the criticism is apparently true that in Stage I of the arms count proposal our side stands to gain more information of potential military value than does the Soviet side. It is difficult to forsee how the negotiations might find a way to bring about an acceptable balance in this respect within the framework of an arms count alone. In combination with a limitations plan, this should be less difficult.

THE PLACE OF THE U.N. MAJORITY PLAN IN PRESENT U.S. POLICY

If the broad outlines of the arms count proposal itself reveal nothing new in American atomic policy, is it still possible to find implications of a change of policy in the proposal and

---

Oppenheimer and Bush Appointed to New Advisory Group on Disarmament

On April 28 the Department of State announced the formation of a panel of consultants to advise and assist the Department of State and other agencies of the government in connection with the work of the United Nations Disarmament Commission. The members of the panel are: Vannevar Bush, Carnegie Institution of Washington; John Dickey, president, Dartmouth College; Allen W. Dulles, deputy director, Central Intelligence Agency; Joseph E. Johnson, Carnegie Endowment for International Peace; and J. Robert Oppenheimer, director, Institute for Advanced Study, Princeton.

The consultants have held their initial series of conferences. They met with the Secretary of State; the U.S. Deputy Representative on the Disarmament Commission, Ambassador Benjamin V. Cohen; Assistant Secretary of State John D. Hickerson; officials of the Defense Department and the Atomic Energy Commission, and members of the interdepartmental staff which has been working actively on this problem for some time.

The panel of consultants will meet at frequent intervals with top officials of the government as the work progresses.

the Paris resolution on which it was based? Before the Soviet entry into the atomic armament race, and when the U.S. stockpile was still small, the Baruch proposal and its evolution into the U.N. Majority Plan was the result of a very enlightened atomic foreign policy. Now, with the rapid growth of competing stockpiles, there are inevitable uncertainties more serious than those which the strict procedures of this plan were designed to prevent. The international ownership device of the plan may thus be considered obsolete, in the sense that procedures offering less dependable guarantees against diversion from production (or permitting no production at all), yet demanding less extensive concessions and thus more likely to find general acceptance, would be better for both sides than no control at all.

The interested segment of the public has been wondering for some time whether within the administration there has been thinking on the subject as sincerely devoted, as concerted, and as constructive as the importance and difficulty of the task demands.[2] One wonders further whether some plan may have been devised which has not been revealed for some good reason having to do with the delicacy of effective behind-the-scenes negotiation. (For example, if a good plan were worked out, it might be good diplomacy to arrange that it be proposed from some relatively neutral and obscure corner of the globe, or else to have the major participants

confer and agree on its principles before disclosing it in open negotiations to public scrutiny, thus neatly separating real disarmament efforts from the "propaganda war.") Such a devious reason for not having proposed another plan does not seem characteristic of our government, but it is a possibility.

Principles of Majority Plan

As recently as at the Paris meetings of the U.N. General Assembly last fall, Secretary Acheson reiterated the statement that the U.S. still stands by the principles of the U.N. Majority Plan. The question arises whether this is an adamant stand or is merely retained as a starting point for negotiations, pending readiness to propose a less demanding plan.

One might think to find an answer in the very spirit of the arms count proposal, with its reliance on inspection alone. The Baruch and U.N. Majority plans are based on insistence that inspection alone is not a completely effective deterrent to diversion of nuclear fuels from production processes, and that international ownership and operation is essential. There is, however, no necessary contradiction between these plans and the arms count proposal. One could consistently rely on inspection to gather the approximate advance information considered helpful for the formulation of a control plan, and still insist on the inadequacy of inspection as an instrument of the actual control operations.

Verification and Control

But in the detailed wording of the arms count proposal one may find definite and encouraging indications that the writers of the plan have gone beyond insistence on the control mechanism of the Baruch plan, as follows:

(Paragraph [1] of the working paper) "Disclosure as of a particular date . . . and subsequent verification of this disclosure would not meet the requirements of a continuing program for the regulation, limitation, and balanced reduction of all armed forces. Therefore, it is contemplated that the machinery which will be set up should be on a permanent or at least a long-term basis . . . ."

(Paragraph [2]) "The system of disclosure and verification is an integral part of the system of safeguards which must be established to ensure observance of the over-all program of regulation, limitation, and balanced reduction of armed forces and armaments so as to provide for the prompt detection of violations, while at the same time causing the minimum degree of interference in the internal life of each country."

Rather clearly, then, the inspection and verification mechanism to be set up in the arms count plan is intended to carry over to the limitations plan, not to be replaced by an international development authority in the special case of atomic arms. There is reference in paragraph [22] to some of the machinery of the U.N. Majority Plan as being applicable to disclosure and verification, but this does not mean the international development authority. There is also mention of a future "separate study" which may further clarify these points.

The discrepancy between this implied disavowal of the U.N. Majority Plan and Secretary Acheson's as yet unretracted explicit insistence on it may be explained in one of three ways:

1. The arms count proposal came several months after the Paris sessions, and the delays[3] before its presentation may indicate that the thinking on it was done largely in the interim. Thus it would indicate a genuine change in administration policy.

2. The discrepancy may indicate a difference of opinion between Secretary Acheson and his advisers on disarmament, the latter having supplied the wording of the proposal.

3. Renouncement of the U.N. Majority Plan may be considered a matter for the U.N. majority, and inadvisable at least from the propaganda point of view before a replacement is ready.

Benediction

There has been a group of men of good will, Professor Niels Bohr of Denmark perhaps foremost among them, who have urged the importance to the unity of the free nations of the world that the U.S. give new evidence of its belief in the principle of openness in the form of an offer to reveal all its military secrets if others would

(*Continued on page 138*)

[2] The very recent creation in the State Department of a high-level Panel of Consultants on Disarmament, an announcement of which appears herewith, is encouraging news, indicating at least some realization of the urgency of the general disarmament problem, and that it is not solved by proposing an arms count alone. The field of general disarmament, including the mechanisms necessary for the control of conventional weapons, is a very broad one; there is no indication in the announcement that the new Panel will concentrate on the atomic aspects of the problem. These aspects by themselves pose a very difficult task, so it cannot be tacitly assumed that the effort of this Panel of part-time consultants, able though the members are, will constitute an attack on the problems of atomic limitations commensurate with the vital importance and urgency of finding a basis for agreement before it is too late. It is greatly to be hoped that the Panel of Consultants will themselves sense the urgency and arrange to expand their facilities to make possible appropriate emphasis of the atomic side of the disarmament problem.

[3] From Feb. 14, when the sessions were to have started at New York, to April 5, when the Soviet verbiage on Chinese sanitation was suddenly terminated.

UNITED NATIONS ATOMIC ENERGY NEWS

U.S. PROPOSALS FOR WORLD ARMS CENSUS

Below is the text of the working paper, entitled "Proposals for Progressive and Continuing Disclosure and Verification of Armed Forces and Armaments," which was submitted by the United States to a committee of the United Nations Disarmament Commission on April 5.

The General Assembly resolution calling for regulation, limitation, and balanced reduction of all armed forces and armaments directs that the Commission be guided by a number of principles, including the following (operative paragraph 3):

"*a*) In a system of guaranteed disarmament there must be progressive disclosure and verification on a continuing basis of all armed forces—including paramilitary, security, and police forces—and all armaments including atomic;

"*b*) Such verification must be based on effective international inspection to ensure the adequacy and accuracy of the information disclosed; this inspection to be carried out in accordance with the decisions of the international control organ (or organs) to be established."

Operative paragraph 5 of the resolution reads as follows:

"5. [The General Assembly] directs the Commission, in preparing the proposals referred to in paragraph 3 above, to consider from the outset plans for progressive and continuing disclosure and verification, the implementation of which is recognized as a first and indispensable step in carrying out the disarmament program envisaged in the present resolution."

It is therefore apparent that the General Assembly resolution contemplated that the newly created Disarmament Commission should as a matter of priority deal with the problem of progressive and continuing disclosure and verification of armed forces and armaments.

A. EXTENT OF DISCLOSURE AND VERIFICATION

(1)

The system of disclosure and verification must be on a continuing basis. Disclosure as of a particular date on a "one-time basis" and subsequent verification of such disclosure would not meet the requirements of a continuing program for regulation, limitation, and balanced reduction of all armed forces. Therefore, it is contemplated that the machinery which will be set up should be on a permanent or at least a long-term basis, since the disclosure and verification of armed forces and armaments will be on a continuing basis.

(2)

The disclosure must cover all armed forces of every kind, including paramilitary, security, and police forces, and all armaments including atomic.

(3)

The verification of armed forces and armaments must likewise cover all armed forces of every kind, including paramilitary, security, and police forces, and all armaments including atomic.

(4)

The permanent machinery to be established must provide adequate safeguard under a competent international authority having appropriate status, rights, and powers.

B. STAGES OF DISCLOSURE AND VERIFICATION

(5)

Disclosure and verification must be carried out step by step with appropriate provisions for proceeding to the next step when, and only when, previous steps have been satisfactorily completed. The reasons for proceeding by stages are two:

a) In the existing state of international tensions, all states must be protected in the event of a serious violation or collapse of the system of regulation, limitation, and balanced reduction of armaments. The existence of stages gives all states the opportunity over a period to test the good faith of all other states. The mere agreement to enter into a system for disclosure and verification would give no assurance that the parties thereto would actually carry it out in full or at all. With disclosure and verification in several stages, and with each step of one stage completed prior to the commencement of the next stage, all states have the opportunity at periodic intervals of checking the good faith of other states through the review of the information theretofore disclosed.

b) It is contemplated that the disclosure and verification would proceed from the less secret areas which would be disclosed and verified in early stages to the more secret areas. A phasing of this nature, in addition to furnishing the best test of the good faith of all states, would cause the minimum degree of interference in the internal life of each country, since the less sensitive information can, in fact, be more readily verified, and would, in cases of differences or delays, prevent premature disclosure of information which many states would like reserved until substantial cooperation and good faith have been demonstrated.

(6)

In considering the appropriate number of stages, the United States had as its objective the full implementation of the program of disclosure and verification as rapidly as feasible in the light of the existing state of international tensions. An excessive number of stages, each of which must be completed prior to the commencement of the next stage, would unduly delay not only the program of disclosure and verification, but also the entire program for regulation, limitation, and balanced reduction of armed forces and armaments. With this in mind, the United States concluded, and is proposing, that the number of stages of disclosure and verification should be five—a figure which represents the minimum number consistent with the considerations set forth in the previous paragraph. In each stage, the disclosure and verification processes will go forward simultaneously on a wide variety of items in order to accelerate the successful completion of the program.

(7)

Annex I sets forth in outline the extent of armed forces and armaments (excluding atomic) to be disclosed in the respective stages and the manner of verification of the information required to be disclosed. Annex II sets forth the same information with respect to atomic armaments. The proposals with respect to atomic weapons are presented in a separate annex solely in the interests of clarity of presentation. Both the problems involved and the appropriate terminology

with respect to atomic weapons differ so greatly from the problems and terminology with respect to other weapons that a single annex comprehending both might be confusing. It is contemplated that all stages of disclosure and verification cover both atomic and nonatomic weapons. In other words, the first stage includes the items set forth both in Annex I and in Annex II for disclosure and verification in that stage, and the same is true as to all succeeding stages.

(8)

Without commenting in detail at this point on the specific items subject to disclosure and verification in the respective stages, it should be noted that the armed forces and armaments to be disclosed in the first stage have three general characteristics:

a) They should prove to be the least secret items.

b) In the main, they are most susceptible of verification by periodic visits of inspection and through reference to statistical records—with the result that verification can take place with the minimum of interference in the internal life of the respective countries. Some resort would nevertheless be required to "on-the-spot" inspection, and aerial reconnaissance would be required in all stages to assist in checking the adequacy of the disclosure.

c) At the same time, these items reveal so vast a segment of the military potential of all states that their disclosure and verification as provided in this stage in and of itself would act as an indication of good faith and would thus greatly facilitate progress toward the ultimate goals of the entire program of regulation, limitation, and balanced reduction of all armed forces and armaments.

(9)

The armed forces and armaments to be disclosed in the second, third, fourth, and fifth stages are progressively more secret and more difficult to verify except through "on-the-spot" investigations in conjunction with extensive aerial reconnaissance.

(10)

The character of the items to be disclosed and verified in the five stages as outlined in Annexes I and II can in general be summarized as follows:

Stage 1.—A quantitative count in the nature of a report on existing strength levels of all armed forces, and of the location of installations and facilities concerned with armaments of all types including atomic.

Stage 2.—Detailed disclosure of organization of armed forces and of installations and facilities concerned with the basic materials required for production of all armaments including atomic.

Stage 3.—Detailed disclosure of armaments (except novel armaments), fissionable material and installations and facilities utilized in their production.

Stage 4.—Detailed disclosure of installations and facilities utilized in the production of novel armaments including atomic (armaments not in general use by the end of the second World War, but in volume production today).

Stage 5.—Detailed disclosure of novel armaments, including atomic.

(11)

The information to be disclosed and verified in all stages—and particularly in the early stages—is so vast that there appear to be advantages in disclosing material only at the rate at which it can be processed. Therefore, in general, within each stage, disclosure should proceed progressively step by step in accordance with an agreed plan from the less sensitive information to that which is more sensitive.

C. INSPECTION

(12)

The system of disclosure and verification is an integral part of the system of safeguards which must be established to ensure observance of the over-all program of regulation, limitation, and balanced reduction of armed forces and armaments so as to provide for the prompt detection of violations, while at the same time causing the minimum degree of interference in the internal life of each country. It will not be adequate to provide merely for the verification of disclosed information. In addition, provision must be made for determining the adequacy of the disclosed information, through broad general powers of "on-the-spot" inspection, through access to statistical data permitting independent confirmation of required reports, and through aerial surveys.

(13)

Extensive aerial reconnaissance is obviously essential to the verification procedure in order completely to determine the adequacy of disclosed information. It will be obvious that aerial reconnaissance furnishes the easiest method of determining the existence of large undisclosed facilities and installations. Aerial surveys will be essential in all stages of the disclosure and verification procedure.

(14)

It is contemplated that "on-the-spot" inspection will take place in all stages as a part of the verification procedure. Its use, however, will be less extensive in the first than in the later stages, because of the greater ease of verification through other methods of the items disclosed in the first stage. It will, of course, be necessary at each stage to regulate inspection in such a way as to prevent disclosure of information which is to be withheld from disclosure and verification during the particular stage. Certain principles governing limitations on the right of "on-the-spot" inspections in early stages are set forth in Annexes I and II.

(15)

Each state at the commencement of each stage should submit to the Commission a general description of the nature and location of facilities falling within the terms of reference for that stage. Access to such locations, reasonably sufficient to verify the information disclosed, should be granted to inspectors. Inspection in each stage should proceed in accordance with a previously accepted plan.

(16)

It is essential to an effective system of verification that the international inspectors, in addition to examining declared installations and facilities, be permitted in all stages to have access to the entire national territory in order that the Commission may determine within reasonable limits the accuracy and adequacy of the information disclosed. Accordingly, each state should be required during each stage of the process of disclosure and verification to permit the international inspectors such freedom of movement and to give them access to such installations and facilities, records and data, as may reasonably be required, including the right to inspect physical dimensions of all facilities and installations wherever situated.

(17)

Each state should facilitate the activities of the international inspectors and furnish to them such assistance as they may reasonably require.

(18)

Procedure should be set up in order to permit a determination by the Commission of the necessity for inspection of any facilities or installations, access to which is denied to the inspectors and where, in the judgment of the inspectors, such inspection is required.

(19)

The inspectors should report to the Commission any information indicating a major violation of any provisions of the treaties or agreements respecting disclosure and verification. In the event of a Commission determination, confirmed by the Security Council by the affirmative vote of any seven members, of such a major violation during any stage, and the failure of the state guilty of violation to repair the same within a reasonable specified period, other states should be free to suspend the operations of the disclosure and verification system.

(20)

The first stage of disclosure and verification should commence upon (*a*) the entry into force of the treaties dealing with the program of disclosure and verification and referred to in operative paragraph 3 of the General Assembly resolution, and (*b*) the establishment pursuant to such treaties of international machinery responsible for carrying out the program of disclosure and verification, including the portion of such machinery located within the territory of states adhering to the program.

(21)

Disclosure and verification in all stages subsequent to the first stage could commence upon a Commission determination that the previous stage has been satisfactorily completed.

D. MISCELLANEOUS

(22)

The United Nations should establish concurrently with, and at the time of, the adoption of the general principles governing this program the necessary inspection machinery to ensure effective verification of the armed forces and armaments, including those involving atomic energy, disclosed pursuant to the program. In establishing this machinery, consideration should be given to its subsequent utilization to supervise the program for the regulation, limitation, and balanced reduction of all armaments and armed forces. The machinery recommended in the United Nations Atomic Energy Plan would presumably be utilized in connection with the disclosure and verification of armaments involving atomic energy. The problem of appropriate United Nations machinery both for purposes of the system of disclosure and verification, and for the regulation, limitation, and balanced reduction of armed forces and armaments is the subject of a separate study.

(23)

It is contemplated that the disclosure and verification processes with respect to all adhering states should begin simultaneously and should go forward at approximately the same tempo.

(24)

The draft treaties or agreements bringing into effect the disclosure and verification system should specifically provide for adherence of states in accordance with the principles set forth in paragraph 5 of the Preamble and paragraph 3 (*e*) of the General Assembly Resolution of January 11, 1952, the relevant portions of which are as follows (Paragraph 5 of Preamble):

"Recognizing that a genuine system for disarmament . . . must be accepted by all nations whose military resources are such that their failure to accept would endanger the system. . ."

Paragraph 3 (*e*):

"The treaty (or treaties) shall specifically be open to all states for signature and ratification or adherence. The treaty (or treaties) shall provide what states must become parties thereto before the treaty (or treaties) shall enter into force."

ANNEX I

Proposed Stages of Disclosure and Verification, Armed Forces and Nonatomic Armaments

STAGE 1

Disclose (*a*) over-all manpower strength of regular and reserve military forces and paramilitary organizations, including training establishments and security and police forces, broken down into each category; (*b*) location of all operational military installations.

Verify (*a*) by examination and cross-checks of central records to include personnel, disbursement, medical and procurement supplemented by access to, and spot checks of, records at selected installations; (*b*) by direct examination, location, manpower used, power input, and physical dimensions of installations. (*a*) and (*b*) Inspectors will have access to entire national territory to extent necessary to determine that all facilities and installations have been declared. Aerial surveys will be permitted for same purpose and to same extent.

STAGE 2

Disclose (*a*) organization, composition, and disposition of units making up over-all strengths disclosed in Stage 1; (*b*) over-all annual capacity of heavy industry relating to armaments to include coal, steel, aluminum, and electricity.

Verify (*a*) by quantitative analysis of records pertaining to personnel, movement of units and administrative support

The Use of Tactical Atomic Weapons

"The history of the past few years has given a world-wide political and propaganda significance to atomic weapons, whether they are full sized A-bombs for strategic bombing of industrial centers or some less powerful weapon for tactical use. In any decision on the use of such weapons, it is essential to take into account the psychological reactions of the people of friendly, enemy, and neutral countries as well as the immediate military objective. It would be a poor bargain if we won a local engagement at the expense of alienating world public opinion. While we do not predict this effect for every possible use of atomic weapons, it seems to us a contingency which should not be ignored in making a decision.

"It should be noted that the term 'Baby A-bomb,' which has been used a good deal in the newspapers, is misleading. Senator McMahon, who is chairman of the Joint Congressional Committee on Atomic Energy and should know, said recently in an interview with the *Bulletin of the Atomic Scientists:* 'They may call them *'Baby Bombs* or *Tactical Weapons* but, if it is an atomic explosion, its destructive power will be so great compared to any conventional kind of weapon as not to admit of fair comparison.' It would be a mistake, then, to consider atomic weapons as 'just one more kind of weapon' and to leave consideration of the effect of their use to military commanders alone. The decision as to whether and when to use atomic weapons of any kind should remain with our highest level civilian authorities.

"Consideration of atomic weapons along with conventional armaments in the United Nations Disarmament Commission, on the other hand, seems essential and we are grateful for the initiative of our government in bringing about the present discussions of the over-all disarmament problem. In this larger context and with the changes in the atomic energy picture since the UN Atomic Energy Commission first met in 1946, it may be possible to achieve some positive results. It is our hope that public attitudes and governmental policies will permit flexibility on the part of American representatives. The awesome prospects of destruction in a new world war should lead this country, as well as all others, to make now the most serious attempt to achieve universal reduction of armaments—with adequate inspection and controls to prevent evasion of the agreements by potential aggressors."

—Council of the Federation of American Scientists, May 4, 1952

supplemented by access to, and spot checks of, selected units and installations; (*b*) by cross-checks of pertinent statistics and employment records, access to plants and analysis of operation with respect to materials used.

(a) and (b) By aerial survey as stated in Stage 1.

STAGE 3

Disclose (a) equipment (including reserve equipment of units making up over-all strengths disclosed in Stages I and II except units equipped with novel weapons); (b) production facilities for manufacture of weapons and heavy equipment for units making up over-all strengths disclosed in Stages I and II (excluding novel weapons), giving location, type, and capacity.

Verify (*a*) by quantitative analysis of records pertaining to table of organization and equipment, and repair and overhaul of equipment supplemented by access to, and spot checks of, selected units and installations; (*b*) by inspection of physical dimensions of plants and examination of records pertaining to consumption of power and raw materials, available labor force and finances, and by access to, and spot checks of, selected units and installations.

(*a*) and (*b*) By aerial survey as stated in Stage I.

STAGE 4

Disclose (*a*) information as to equipment of units equipped with novel weapons to include biological warfare, chemical warfare, radiological warfare, and atomic weapons (*b*) installations and facilities devoted to manufacture of novel weapons.

Verify (*a*) by cross-checks with Stages I and II and quantitative inspection of units disclosed; (*b*) by inspection of physical dimensions of plants and examination of records pertaining to consumption of power and raw materials, available labor force and finances, and by access to, and spot checks of, selected units and installations.

(*a*) and (*b*) By aerial survey as set forth in Stage I.

STAGE 5

Disclose (*a*) quantities of novel weapons on hand by types.

Verify (*a*) by physical count of stockpiles of finished novel weapons cross-checked with information disclosed in Stages 1, 2, 3, and 4.

ANNEX II

Proposed Stages of Disclosure and Verification, Atomic Armaments

STAGE 1

Disclose (*a*) location of all installations directly concerned with production of atomic energy, or the product of which is primarily useful in the production of atomic energy. Also manpower employed, physical dimensions, and power input of each installation. (Excluding weapon storage sites); (*b*) uses for functions of these installations. This should be confined to a statement giving the input material, the produce material, and the process used in each instance.

Verify (*a*) by direct examination, location, manpower used, power input, and physical dimensions of installations. (Inspectors will have access to entire national territory to the extent necessary to determine through such means as aerial survey, inspection of water and railways and power lines, that all atomic energy installations have been declared); (b) uses and functions insofar as revealed by external examination of all structures and unhoused equipment. Detailed interior inspection shall take place depending upon the function of the plant. (Verification of (*a*) above will be of value as partial verification of plant use or function.)

(*a*) and (*b*) By aerial survey in all stages for some purposes and to same extent as permitted with armed forces and nonatomic armaments. (See Annex I.)

STAGE 2

Disclose (*a*) details of design and operation, including present and past output, of all those installations or parts of installations concerned with preparation of atomic energy, raw or feed materials (and such auxiliary materials as graphite, heavy water, and beryllium), from mines up to, but not including, reactors, isotope separation plants, and similar nuclear conversion devices used to produce fissionable or fusionable material.

STAGE 3

Disclose (*a*) details of design and operation, including present and past output of all those atomic energy installations, or parts of installations, concerned with the conversion of feed materials to fissionable or fusionable materials, or with the preparation of radioactive materials in large quantities; (*b*) amounts and types of fissionable or fusionable material on hand or in process; amounts and types of radioisotopes on hand or in process; (*c*) general design and operational characteristics of research laboratories involving reactors operating at a power level of 1 MW or more, including amounts of radioactive, or fissionable or fusionable materials produced.

Verify (*a*) by direct and detailed inspection of all aspects of the installations and appropriate records. Cross-checks with Stages 1 and 2; (*b*) by direct and detailed inspection of fissionable or fusionable material, or radioactive materials, installations for production thereof, and appropriate records; (*c*) by survey of facilities associated with reported reactors, by detailed inspection of reactors themselves.

STAGE 4

Disclose (*a*) details of design and operation, including past and present output of all those atomic energy establishments and installations concerned with the fabrication of atomic or radioactive weapons from fissionable or other materials.

Verify (*a*) by direct and detailed inspection of installations and appropriate records. Cross-checks with Stages 1, 2 and 3.

STAGE 5

Disclose (*a*) location, number and types of atomic and radioactive weapons on hand. Weapon storage sites.

Verify (*a*) by direct inspection. Cross-checks with Stages 1, 2 and 3 and (*a*) above.

Inglis: U.S. Atomic Policy

(*Continued from page 134*)

do likewise. Though perhaps not publicized in quite that manner, the arms count proposal does just this, while opening definite negotiations. The unity of the free world can serve the needs of short-range security, and can contribute indirectly to the prompt effectiveness of negotiations for atomic control which will serve the long-range needs of survival. This helpful aspect of propaganda cannot alone solve the long-range problem. Much more ingenious thought than has as yet been evidenced in the negotiations is needed to balance the incentives and the concessions on both sides. May the statesmen of the world who guide national policies and may the direct negotiators on the U.N. Disarmament Commission overcome the temptation to sink into frustrated failure; may they instead devote to the task the type of inspired effort that it continues to deserve, and before it is too late may they succeed in dissolving the nightmare of the earth as an atomic sorcerer's apprentice, with no magic to call a halt.

Does the Neutrino *Really* Exist?

By S. M. DANCOFF

The following article is a lecture given by Sidney Dancoff, a young professor of theoretical physics at the University of Illinois, a few months before his untimely death last summer. The text published here was drawn from notes found among his papers and not prepared by him for publication. The editors decided to leave the manuscript in this form as a vivid memoir of Dr.Dancoff's brilliant and original lecture art. Some of our readers may find food for thought in the comparison of the theoretical physicist's attitude toward physical theory, as expressed by Dancoff, with the point of view put forward by Pope Pius XII in his speech on cosmogony reproduced in this issue.

I MUST admit at the beginning that this isn't a very good title for the talk I propose to give. In fact, the choice of a brief but accurate title presented somewhat of a problem. Perhaps the best short name for the talk would be something like the following: "Does the announced title for today's lecture make any sense?"

My thesis will be: No, it doesn't make any sense to argue about questions like the reality of the neutrino, or for that matter of the electron or proton. I would hold such discussions to be meaningless and based on a misunderstanding of the proper role of the electron, proton, neutrino, etc., in physics. I'll do my best to justify for you my view on this matter.

Probably it's not necessary to remind you that arguments of the sort "Is the neutrino a particle?"—"Is the neutrino a real particle," and other variations—crop up around here pretty often, namely every time Professor Sherwin makes a report on his neutrino research. Now with Professor Allen joining our staff and adding his reports on his neutrino research, it would appear that the arguing is going to get pretty serious and it strikes me that it would be worthwhile to try to dispose of the matter once and for all, if possible.

First, I would like to review the situation with regard to the neutrino. You recall that in radioactive beta decay of a nucleus, an ordinary electron is observed to come off. The energy is not fixed, but in a large sample of decaying atoms the electrons coming off have an energy from 0 up to a certain maximum. On the other hand, the difference in energy between initial and final nucleus is known to be always precisely E_{max}. Then what happens to the extra energy in the cases when the electron takes off less than E_{max}? Pauli postulated that this was removed by another particle called the neutrino. Since experimental tests to date have failed to give any evidence of the escape of such a particle from the source region, it has been necessary to assign the particle just exactly those properties that would enable it to get away without being detected. Namely, it has to have zero rest mass, no charge, no magnetic moment (or very small).

Fermi formulated Pauli's suggestion into a theory which involved the use of the neutrino as a concept. With this theory, Fermi could predict the form of the electron distribution curve, and the best evidence seems to indicate that the prediction agrees with experiment. He could predict radioactive decay rates, and these too seem to be about right. Everywhere that the theory can be subjected to test, it appears to hold up well. In the most recent extremely delicate recoil tests of Professors Sherwin and Allen there seems every evidence that the theory checks on the momentum which the nucleus gets after beta decay. That is, this momentum is what you would get if an electron plus a neutrino were emitted in the process.

As to the neutrino itself, it is apparently gone and never heard from again. According to theory, the chance of stopping it somewhere is very tiny and much too small for present experimental techniques. In other words we don't notice it while it's around but miss it only after it's gone away.

This being the case, it has been said by some that the neutrino has not yet become respectable, not acquired full stature as a particle—sort of a hypothetical particle when compared to others which are more real. This is what we want to talk about.

Problem of Terminology

Now, when we ask what is and what isn't a particle, we have to keep in mind very clearly the point that Professor Hartree emphasized in one of his lectures here. When you set out in a new field and choose a terminology you have the choice of using old, familiar words in new meanings or else you can make up new words for the new meanings. If you use old words you make the theory look homey and inviting, but you run the risk of confusing the issue every time the old word is used. If you use new words you make the thing look excessively highbrow and frighten off any who might be interested.

In the case of electron, proton, neutron, neutrino, etc., physicists used an old word—"particle"—but they gave it a new meaning, a very very new meaning. I believe that here is a place we could well have afforded to use a new

word, because an enormous amount of confusion results when people try to apply to these "particles" ideas they've always had about what particles should be like.

Example of "Electron"

Let's consider a "particle" that has achieved considerable respectability, the electron. Let's ask: What is an electron?—is it a particle?—does it *really exist?*

It's an obvious fact that no one has ever seen an electron, no one has ever weighed an electron, felt an electron, or in fact made any observation whatever on an electron. What we have seen are certain experimental phenomena—scintillations of a screen, water droplets in a cloud chamber, deflections of a dial, black spots on a photographic plate, etc. By themselves, they represent just a lot of observations having no particular connection with each other. But when we use the Schrodinger wave equation, or perhaps the Dirac wave equation, we find that it's possible to calculate the results of the various experiments mentioned and get agreement between theory and experiment.

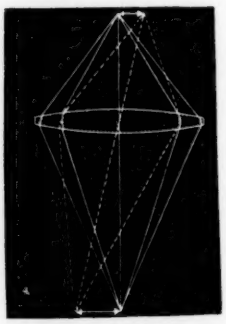
Notice that all that's entered here are the experimental data on the one side and some equations on the other, along with rules for calculating from the equations. At no time has the idea of a particle entered; in fact it would be possible to dispense entirely with the word electron and yet not affect the procedure of comparing experiment with theory. Strictly speaking, an electron is merely that thing—that state of affairs—which is defined by Schrodinger-Dirac theory.

Role of Theory

Now I must say a word about the role of theory in physics. In physics we start with experiments—always with experiments. We write down the results of many experiments on a sheet of paper. If all the experiments are entered, it has to be a very big sheet of paper indeed. In fact, we have decided this method of storing the data is rather clumsy; wouldn't it be nicer if we could find some neater, more abbreviated way to do the job? So we set to work some characters with badly-kept hair, called "theorists," whose job it is to find some trick way of correlating the data in as big lumps as possible. The theorist works a while, then tells you: "All the data in this region over here—plus a little of the data over here, plus some over there—can be all correlated together and simultaneously by means of this equation, using *these* rules for calculating experimental results from the equation."

Then along comes another theorist with the announcement: "That's all very well what you say, but I've got a better equation because I can correlate even more of the data with my equation." And so we consider the second theory to be an advance over the first one.

Generally speaking, these theoretical formulations are of such a nature that they can be extrapolated. That is, they can be used to predict the results of experiments that have not yet been performed. Now if this extrapolation is not too great, it usually works out that the theory holds up more or less well. But if the new experimental conditions are greatly different from the ones for which the theory was derived, the extrapolation generally fails, and a new theory, or new correlation has to be worked out.



Place of "Electron" in Theory

The Schrodinger-Dirac theory is just such a correlation. It gives very accurately the results of a large number of experiments. Now where does the electron come in? When I use the word electron, I mean the Schrodinger-Dirac theory, neither more nor less. I don't think there's anything else you can mean and still make sense. The particle name is simply a title to differentiate for convenience one group of data from another. In other words I would say: "Electron" ≡ Theoretical Formulation ≡ Group of data."

When one asks: "Does the electron exist"—that is the same as asking: "Do the data exist? Are the experiments real?"

I realize that in the course of this talk, I am being more dogmatic than is customary in a physics lecture, and I apologize for this. My excuse is that I have found in discussing this subject that it is very hard to make oneself understood. In any case, there will be plenty of opportunity for rebuttal from those who view the matter differently.

Existence of Electron

There are many who want to think of the electron as something more than a convenient grouping of data. They like to think that in some extra-physical sense there "really is" an electron. I don't know what that means, but I'm describing as well as I can the position of others. The physicists of whom I'm speaking feel that an electron exists independently of our experiments and theory. It is really, absolutely there.

I don't say that such a point of view can be shown to be logically false. I wouldn't try to do that. But I do think it is a very dangerous and unproductive point of view. It actually hampers the work of physics.

Now take this question of the electron. If it "really, truly exists," then how dare we, for example, try to describe nature in terms of any theory that doesn't have electrons in it? To a believer in the reality of the electron such a theory would be unimaginable. But theorists don't want to be bound in developing new theories by somebody's prejudice about what it is that really exists. If I can find a new theory which is superior to quantum mechanics and which doesn't mention electrons anywhere, then away with electrons—let's hear no more about them! But the man for whom electrons have become real and unquestionable is forever limited in his conception of possible new theories.

We have all heard about how the electron has properties like those of a particle and also others like those of a wave. That is to say, the solutions of Schrodinger's equation exhibit similarity in some cases to classical equations describing the motion of a point particle. Under other conditions the solutions of Schrodinger's equation are more like those of wave motion as in optics. The believers in the absolute reality of the electron will often say, for example, that the electron really is a particle but it is the perversity of nature which prevents us from making exact measurements on this particle. We see this particle only through a ground glass, darkly. There is a principle, unfortunately called by some the uncertainty principle, which is said to express the limitations on measuring

the position and velocity of the electron. I prefer to say there is no uncertainty involved anywhere. It is not necessary to assume that there really is a point electron; consequently, there is no position and velocity of anything to be uncertain about. The electron may behave only approximately like a particle, or approximately like a wave. But it always behaves precisely and without any uncertainty, like a solution of Dirac's equation, i.e., precisely like an electron.

The Case of the Neutrino

Now let's get back to the case of the neutrino. As I've said, Fermi developed a theory which gave a good account of the experimental data known at that time. The wider implications, or extrapolations of his theory have been tested and one by one they have seemed to stand the test, at least so far.

It pleased Fermi to designate a certain set of symbols by the word "neutrino." These symbols were an integral part of his theory. Their use is just as important as anything else in his theory for any experimental result that is calculated from it. Now I think Fermi had just as much right to name these symbols and their associated properties "neutrino" as he had to name his own daughter. There is no question as to whether these symbols describe something which "really exists"—the only things that "really exists" as far as a physicist is concerned are the data, and Fermi's theory is in agreement with them.

I will now address myself to those of you who are not convinced by my previous arguments and continue to feel that the neutrino is not as real as some other particle or is not as respectable. Undoubtedly, being fair-minded people you have a set of crucial tests which you feel the neutrino should pass—prelims, so to speak. Maybe you want neutrinos to be produced artificially; perhaps you insist on the development of a neutrino detector. Some will be satisfied with a little less, others will want more, but each of you has in his mind some crucial experiment, after which you will break down and take neutrinos to your bosom.

Being talented physicists, you will perhaps undertake one or more of these crucial experiments yourself. With the advances to be expected in techniques it may be that you will actually before long be able to detect a neutrino. You may learn how to produce neutrinos artificially. You may learn how to observe the scattering of neutrinos, how to measure radiation from neutrinos.

As knowledge about the properties of neutrinos increases, new technical achievements will become available. You will be able to make neutrinos follow helical paths—to bounce up and down like rubber balls. You may even be able to fashion a club out of neutrinos with which to hit theoretical physicists on the head.

Finally, practical uses for neutrinos will appear and multiply. They will be used to power space ships, new plastics will be made out of them, they will become the essential ingredient in a nourishing soup.

You will become ashamed that you ever doubted that neutrinos "really existed." You will come to be very fond of the neutrino. You will love it as a son. You will say: "There is a fine particle, a *real* particle."

Out-Moding the Neutrino

At that time, however, some theorist will get up and say: "Too late—the neutrino is out! We have a new theory now. Everything gets described in terms of a series of inversions of the space-time metric. We can include in this way all atomic, nuclear, gravitational, electromagnetic phenomena, and lots more. And it can all be written down on a half sheet of paper. We're all through with protons, neutrons, electrons, mesons, neutrinos, and all that nonsense. We use just a single concept now—we call it the metricon. The theory is completely worked out—in some unpublished notes of J. Schwinger."

And so, after all the trouble of getting yourself convinced that the neutrino *really exists* you suddenly find yourself left holding the sack—of neutrinos. And if I'm not mistaken, your first reaction will be to attack the new theory on the grounds that the metricon is not a real particle—it doesn't really exist.

You all know about the terrible shock to the nervous system the world of physics got at the beginning of this century when it was forced to swallow the double dose of relativity and quantum theory. Probably the great majority of physicists found that they were asked to surrender hallowed and cherished concepts that had become set in granite for them. Many of them balked and refused to have anything to do with the new theories.

It has been asked what we can do to guard against having ourselves terribly shocked in a similar way by the next radical new development that comes along. I would say that one of the things we must be most careful about is to refrain from attaching any absolute reality to concepts like the electron, energy, mass, etc. They are useful, they are expedient, but they are also expendable.

Thus, when someone says he doubts that the neutrino is a real particle, I am concerned not so much with his ideas about the neutrino, but rather with the *implication* that some other particles *are* real—real in the sense that when you describe the universe by using the particle you're speaking truth, but if you don't use this particle in your description, then you're getting involved in error. This is actually an article of faith, and like any other article of faith it cannot be proved or disproved on physical or logical grounds. But, as I've attempted to show, the holding of a belief in the absolute reality of any given concept is a dangerous thing and inimical to the progress of research.

Summary

To summarize—the concept of a particle, such as an electron, neutrino, etc., may be considered simply a chapter heading in some book of theoretical calculations. Each chapter covers all the calculations on a certain class of experiments. If the results of the calculations check the experiments, then the theory is good, and the concept may be said to be *suitable,* or *appropriate.*

The neutrino appears to be an appropriate concept on the basis of all experiments performed to date relating to Fermi's theory. As to whether it is something more, something *real* in some sense or other, it doesn't appear possible to define that question in a physically meaningful way.

Coming back finally to the question of the title of this lecture, I think we can now see how to modify it so as to give a better description of the talk. We simply add two short words: Who cares?

With this I retire and await the deluge.

Science and the Catholic Church

TWO DOCUMENTS

We here reprint excerpts from two important pronouncements by Pope Pius XII, defining the attitude of the Catholic church toward science.

The first document, an Encyclical Letter, dated August 12, 1950, deals with the theory of evolution; *the second, a speech by the Pope to the Pontifical Academy, delivered on November 28, 1951, with cosmogony. The two documents repudiate literal interpretation of the biblical story of the origin of the world and of mankind, and sanction its interpretation as a symbolical narrative, adapted to the understanding of primitive nations. Although this reconciliation of the Bible with natural science had been foreshadowed in the writings of earlier philosophers of Catholicism, beginning with St. Thomas, it has never been announced before,* ex cathedra, *in such clear words.*

The Encyclical Letter calls the theory of evolubody, an "open question," a legitimate subject of scientific inquiry.

The speech gives a much less restrained approval to the evolution theory in cosmology; in fact, it praises modern astrophysics for having disclosed to mankind for the first time, the true story of the creation of the material world.

Lest the endorsement by the Catholic church of the teachings of modern cosmogony and its tolerant attitude toward evolutionary biology be taken as the sign of a general movement of Catholic dogma toward rationalism, it may be recalled that the same Pope, on November 1, 1950, has also added to this dogma the belief in the bodily Assumption into Heaven of the Virgin Mary.

I
"Humani Generis"

Papal Encyclical, August 12, 1950[1]

A GLANCE at the world . . . will familiarize us, easily enough, with the false directions which the thought of the learned often takes. Some contend that the theory of evolution, as it is called—a theory which has not yet been proved beyond contradiction even in the sphere of natural science—applies to the origin of all things whatsoever. Accepting it without caution, without reservation, they boldly give rein to monistic or pantheistic speculations which represent the whole universe as left at the mercy of a continual process of evolution. . . .

These false evolutionary notions, with their denial of all that is absolute or fixed or abiding in human experience, have paved the way for a new philosophy of error. Idealism, immanentism, pragmatism, have now a rival in what is called "existentialism." Its method, as the name implies, is to leave the unchanging essences of things out of sight, and concentrate all its attention on particular existences. . . .

We find some comfort in the contemplation of a different school of thinkers. Not a few of the moderns, reacting from the dogmas of the rationalism in which they were brought up, are thirsting afresh for the wells of divine revelation. They recognize and proclaim the Word of God, preserved for us in Holy Scripture, as the foundation of Christian teaching. But many of them, alas, in their determination to hold fast by God's word, banish the exercises of human reason. . . .

The Teaching of the Church leaves the doctrine of Evolution an open question, as long as it confines its speculations to the development, from other living matter already in existence, of the human body. . . . In the present state of scientific and theological opinion, this question may be legitimately canvassed by research, and by discussion between experts on both sides. At the same time, the reasons for and against either view must be weighed and adjudged with all seriousness, fairness, and restraint; and there must be a readiness on all sides to accept the arbitrament of the Church, as being entrusted by Christ with the right to interpret the Scriptures, and the duty of safeguarding the doctrines of the faith. . . . There are some who take rash advantage of this liberty of debate, by treating the subject as if the whole matter were closed—as if the discoveries hitherto made, and the arguments based on them, were sufficiently certain to prove, beyond doubt, the development

[1] Taken from the translation prepared by Monsignor R. A. Knox for the *Tablet*, CXCVI, 187–90.

of the human body from other living matter already in existence. They forget that there are certain references to the subject in the sources of divine revelation, which call for the greatest caution and prudence in discussing it.

There are other conjectures, about polygenism (as it is called), which leave the faithful no such freedom of choice. Christians cannot lend their support to a theory which involves the existence, after Adam's time, of some earthly race of men, truly so called, who were not descended ultimately from him, or else supposes that Adam was the name given to some group of our primordial ancestors. It does not appear how such views can be reconciled with the doctrine of original sin, as this is guaranteed to us by Scripture and tradition, and proposed to us by the Church. Original sin is the result of a sin committed, in actual historical fact, by an individual man named Adam, and it is a quality native to all of us, only because it has been handed down by descent from him. . . .

It was clearly laid down in that letter [Romans, V, 12–19] that the first eleven chapters of Genesis, although it is not right to judge them by modern standards of historical composition, such as would be applied to the great classical authors, or to the learned of our own day, do nevertheless come under the heading of history; in what exact sense, it is for the further labors of the exegete to determine. These chapters have a *naif*, symbolical way of talking, well suited to the understanding of a primitive people. But they do disclose to us certain important truths, upon which the attainment of our eternal salvation depends, and they do also give a popularly-written description of how the human race, and the chosen people in particular, came to be. It may be true that these old writers of sacred history drew some of their material from the stories current among the people of their day. So much may be granted; but it must be remembered on the other side that they did so under the impulse of divine inspiration, which preserved them from all error in selecting and assessing the material they used.

II
Theology and Modern Science

Pope Pius XII on the Harmony of the Work of God[2]

By your research, your unveiling of the secrets of nature, and your teaching of men to direct the forces of nature toward their own welfare, you preach at the same time, in the language of figures, formulas, and discoveries, the unspeakable harmony of the work of an all-wise God.

Indeed, according to the measure of its progress, and contrary to affirmations advanced in the past, true science discovers God in an ever-increasing degree—as though God were waiting behind every door opened by science. We would even say that from this progressive discovery of God, which is realized in the increase of knowledge, there flow benefits not only for the scientist himself when he reflects as a philosopher—and how can he escape such reflection?—but also for those who share in these new discoveries or make them the object of their own considerations. Genuine philosophers profit from these discoveries in a very special way because, when they take these scientific conquests as the basis for their rational speculations, their conclusions thereby acquire a greater certainty. . . .

If the primitive experience of the ancients could provide human reason with sufficient arguments to demonstrate the existence of God, then, with the expanding and deepening of the field of man's experiments, the mark of the Eternal One is discernible in the visible world in ever more striking and clearer light. Hence it seems helpful to re-examine on the basis of new scientific discoveries the classical proofs of the Angelic Doctor (St. Thomas, 1 p., q. 2, art. 3); that is to say, to inquire whether, and in what degree, a deeper knowledge of the structure of the macrocosm and the microcosm contributes toward strengthening these philosophical arguments.

TWO ESSENTIAL CHARACTERISTICS OF THE COSMOS

From St. Thomas' five "modes of being" of the world around us, which, in greater or less degree of comprehension, are noted with equal evidence by both the philosopher and the human mind in general, there are two which modern science has, in a marvelous degree, fathomed, verified, and deepened beyond all expectations: (1) the mutability of things, including their origin and their end; and (2) the teleological order which stands out in every corner of the cosmos. The contribution thus made by science to the two philosophical arguments, which hinge on these facts and which constitute the first and the fifth ways of St. Thomas, is most notable. To the first way physics, especially, has provided an inexhaustible mine of experiments, revealing the fact of mutability in the deepest recesses of nature, where previously no human mind could even suspect its existence and vastness. Thus physics has provided a multiplicity of empirical facts which are of tremendous assistance to philosophical reasoning. . . .

THE MUTABILITY OF THE COSMOS

In the Macrocosm

At first sight, it is rightly a source of wonder to recognize how the knowledge of the fact of mutability has gained ever greater ground, both in the macrocosm and in the microcosm, according as science has made new progress, as though confirming with new proofs the theory of Heraclitus: "Everything is in flux." As is known, our own everyday experience brings to light an immense number of transformations in the world around us, both near and far away, particularly the local movement of bodies. But, over and above all these local movements strictly so-called, the manifold chemico-physical changes which take place in the world are equally noticeable, as, for example, the

[2] Excerpts from the allocution which Pope Pius XII delivered on November 28, 1951, when he attended the opening of the new academic year of the Pontifical Academy of Sciences.

change in the physical state of water in its three phases of steam, liquid, and ice. We are aware, also, of the far-reaching chemical effects produced by the use of fire, the knowledge of which goes back to pre-historic times, and of the weathering of rocks and the corruption of vegetable and animal life. This common experience is corroborated by the natural sciences, which have taught people to understand these and other similar changes as processes of destruction and construction of corporeal substances in their chemical elements; that is to say, in their tiniest parts—the chemical atoms. Going still further, natural science made known that this chemico-physical mutability is not, as the ancients thought, restricted to terrestrial bodies, but even extends to all the bodies of our solar system and of the great universe, which the telescope, and still more the spectroscope, have demonstrated to be composed of the same kind of atoms.

Nevertheless, in the face of the undeniable mutability of even inanimate nature, there still rises the enigma of the unexplored microcosm. It seemed, in fact, that, unlike the organic world, inorganic matter was in a certain sense immutable. Its tiniest parts, the chemical atoms, were indeed capable of combining in most various ways, but they appeared to be endowed with a privilege of eternal stability and indestructibility, since they emerged unchanged from every chemical synthesis and analysis. . . .

But . . . toward the end of the last century, this oversimplified conception of the chemical atom was shattered by modern science. The growing knowledge of the periodic system of chemical elements, the discovery of the corpuscular radiations of radioactive elements, along with many other similar facts, have demonstrated that the microcosm of the chemical atom, with dimensions measured in ten-millionths of a millimetre, is a theater of continuous mutations, no less than the macrocosm known to all. . . . From the electronic structure of the atom there emanate radiations of light and heat which are absorbed by outside bodies, corresponding to the energy level of the electronic orbits. In the exterior parts of this sphere there takes place the ionization of the atom and the transformation of energy in the synthesis and analysis of chemical combinations.

At that time, however, it was possible to suppose that these chemico-physical transformations provided one last refuge for stability, since they did not reach the very nucleus of the atom, which is the seat of its mass and of the positive electric charge which determine the place of the chemical atom in the natural system of the elements, and where it seemed science had found, so to speak, an example of an absolutely stable and invariable being.

And in the Nucleus

But, by the dawn of the new century, the observation of radioactive processes, which, in their last analysis, were connected with a spontaneous breaking down of the nucleus, began to exclude any such example. Hence, once science had established the fact of instability, reaching down into the deepest depths of known nature, there still remained one further perplexing fact, since the atom was apparently unattackable, at least by human forces, because in the beginning all efforts to hasten or to retard its natural radioactive disintegration, or even to break down inactive nuclei, had failed. The first very modest attempt to break down the nucleus (of nitrogen) goes back to hardly more than three decades ago, and it is only in recent years that it has been possible, by bringing into play tremendous forces, to produce very numerous processes involving the formation and the breaking down of nuclei. Although this result—which, in so far as it contributes to the cause of peace, is certainly to be inscribed among the glories of our century—represents in the field of practical nuclear physics no more than a preliminary step. Nevertheless it provides for our consideration an important conclusion; namely, that atomic nuclei are indeed, by many orders of magnitude, more firm and stable than ordinary chemical compositions; but, this notwithstanding, they are also, in principle, subject to similar laws of transformation, and hence are mutable.

At the same time, it was possible to establish that such processes have the greatest importance in the economy of energy of the fixed stars. In the center

"The Soviet Union Alone Has a Theory"

"In the USSR, the scientific explanation of the origin of the earth interests not only a small group of scientists. It is the cornerstone of the materialist conception of the world, and therefore evokes vivid interest of the widest masses of the people. Awakened by the revolution, penetrated by the creative ideas of Marxism-Leninism, the Soviet man refuses to admit that this question should remain open; he requires that Soviet scientists give a clear and unequivocal answer to it. . . . The result is that the Soviet Union alone has a detailed cosmogonic theory, explaining the fundamental characteristics of the planetary system.

". . . The outstanding characteristics of the Stalinian era appear (in this theory) with increasing clarity and precision. The first and most important of them is a conscious and consequent materialism. . . . The second . . . is that it reflects the superior thought which feeds itself on dialectic materialism. . . . The third . . . is the audacity with which it (Soviet science) poses new problems . . . —an audacity quite different from the lack of restraint, the mania for essays, that characterize the cosmogony of foreign countries. When we make new hypotheses, we base them on facts.

"A final characteristic of Soviet cosmogony is its optimism. For us, the origin of the earth is . . . a question that has come to complete maturity. . . . We consider (it) completely soluble, not only in principle . . . but also in the sense that we can solve it in our own time and by our own efforts."

—Professor O. I. Schmidt,
Soviet geographer and astronomer,
in *Origin of the Earth and the Planets*

of our sun, for example, according to Bethe, and in the midst of a temperature which goes as high as some twenty million degrees, there takes place a chain reaction returning upon itself, in which four hydrogen nuclei combine with one nucleus of helium. The energy thus liberated comes to compensate the loss involved in the radiation of the sun itself. Also in modern physical laboratories, through bombardment with particles endowed with tremendous energy, or with neutrons, successful efforts are being made to effect transformations of nuclei, as can be seen in the example of the atom of uranium. . . .

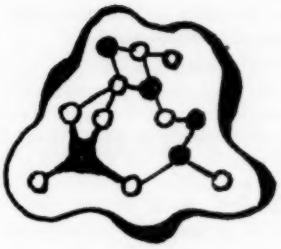
The scientist of today, directing his gaze more deeply into the heart of nature than his predecessor of a hundred years ago, knows well that inorganic matter is, so to speak, in its innermost being, countersigned with the stamp of mutability, and that, consequently, its existence and its subexistence demand a reality entirely different, and one which is by its very nature invariable.

Just as in a picture done in chiaroscuro the figures stand out on a background of darkness, and only in this way achieve the full effect of form and life, so also the image of the Eternally Immutable Being emerges clear and resplendent from the torrent which snatches up and carried off with itself all the material things of the macrocosm and the microcosm in an intrinsic mutability which knows no pause. The scientist who stops on the brink of this immense torrent finds repose in that cry of truth with which God defined Himself: "I am what I am" (Exodus, iii, 14), the God to whom the Apostle gives praise as to the *Pater luminum, apud quem non est transmutatio neque vicissitudinis obumbratio* (James, i, 17).

THE DIRECTION OF TRANSFORMATIONS

In the Macrocosm; the Law of Entropy

Modern science has not only widened and deepened our knowledge of reality and the vastness of the mutability of the cosmos; it likewise provides us with valuable indications on the direction taken by the processes of nature. As late as a hundred years ago, especially after the discovery of the law of the conservation of energy, it was thought that natural processes were reversible. Consequently, in conformity with the principles of the strict causality, or rather the determination, of nature, an ever-recurring renovation and rejuvenation of the cosmos was regarded as possible. Through the law of entropy, however, discovered by Rudolph Clausius, it was recognized that the spontaneous processes of nature are always accompanied by a diminution of free and utilizable energy. In a closed material system this conclusion must lead, eventually, to the cessation of processes on a macroscopic scale. This unavoidable fate, from which only hypotheses—sometimes unduly gratuitous—such as that of continued supplementary creation, have endeavored to save the universe, but which instead stands out clearly from positive scientific experience, postulates eloquently the existence of a Necessary Being.



In the Microcosm

In the microcosm, this law, which is basically statistical, is not applicable. Besides, at the time when it was formulated, practically nothing was known regarding the structure and the behavior of the atom. However, recent atomic research, as well as the unexpected progress of astrophysics, have made it possible to achieve surprising discoveries in this field. Here We can only allude briefly to the results of these discoveries, but they can be summarized by saying that both atomic and intra-atomic development are clearly marked with a sense of direction.

To illustrate this fact, it will be sufficient to cite the example, already mentioned, of the behavior of solar energy. The electronic structure of the chemical atoms in the sun's photosphere releases at every moment into the surrounding space a gigantic quantity of radiant energy which does not return. This loss is compensated from within the sun through the formation of helium from hydrogen. The energy thus released comes from the mass of the hydrogen nuclei, which, in the course of this process and in a small degree (7 per cent), is converted into equivalent energy. Therefore, the process of compensation takes place at the expense of the energy which, originally, in the hydrogen nuclei, exists as a mass. Thus, in the course of billions of years, through a process which is slow yet irreversible, this energy is transformed into radiations. A similar process is found in all radioactive processes, whether they be natural or artificial. Thus here also, in the microcosm strictly and properly so-called, we find a law indicating the direction of evolution, a law which is analogous to the law of entropy for the macrocosms. The direction of spontaneous evolution is determined through the diminution of utilizable energy in the structure and the nucleus of the atom, and, up to the present time, science knows of no processes capable of compensating or annulling this exploitation through the spontaneous formation of nuclei having high energy value.

If the scientist turns his attention from the present state of the universe to the future, even the very remote future, he finds himself constrained to recognize, both in the macrocosm and in the microcosm, that the world is growing old. . . .

THE BEGINNING OF THE UNIVERSE

Everything seems to indicate that the material universe had in finite times a mighty beginning, provided, as it was, with an indescribably vast abundance of energy reserves, in virtue of which, at first rapidly, and then with increasing slowness, it evolved into its present state.

This naturally brings to mind two questions:

Is science in a position to state when this mighty beginning of the cosmos took place? And, secondly, what was the initial or primitive state of the universe?

The most competent experts in atomic physics, in collaboration with astronomers and astrophysicists, have attempted to shed light on these two difficult but extremely interesting problems.

First of all, to quote some figures—which aim at nothing else than to give an order of magnitude fixing the dawn of our universe, that is to say, to its beginning in time—science has at its disposal various means, each of which is more or less independent of the other, although all converge. We point them out briefly.

The examination of various spiral nebulae, especially as carried out by Edwin W. Hubble at the Mount Wil-

son Observatory, has led to the significant conclusion, presented with all due reservations, that these systems of galaxies tend to move away from one another with such velocity that, in the space of thirteen hundred million years, the distance between such spiral nebulae is doubled. If we look back into the past at the time required for this process of the "Expanding Universe," it follows that, from one to ten billion years ago, the matter of the spiral nebulae was compressed into a relatively restricted space, at the time the cosmic processes had their beginning.

The Age of the Solid Crust of the Earth

To calculate the age of original radioactive substances, very approximate data are taken from the transformation of the isotope of uranium 238 into an isotope of lead (RaG), or of an isotope of uranium 235 into actinium D (AcD), and of the isotope of thorium 232 into thorium D (ThD). The mass of the helium thereby formed can serve as a means of control. This leads to the conclusion that the average age of the oldest minerals is at the most five billion years.

The Age of Meterorites

The preceding method, adopted to determine the age of meteorites, has led to practically the same figure of five billion years. This conclusion assumes special importance from the fact that today the interstellar origin of meteorites is generally admitted by all.

The Stability of the Systems of Double Stars and Starry Masses

The oscillations of gravitation between these systems, as also the attrition resulting from tides, again limit their stability within a period of from five to ten billion years.

Although these figures may seem astounding, nevertheless, even to the simplest of the faithful, they bring no new or different concept from the one they learned in the opening words of Genesis, *In principio*—that is to say, at the beginning of things in time. The figures We have quoted clothe these words in a concrete and almost mathematical expression. . . .

ORIGINAL MATTER

In addition to the question of the age of the cosmos, scholars have, with similar earnestness and liberty of research and verification, turned their daring genius to the other problem which has already been mentioned and which is certainly more difficult: What was the state and quality of primitive matter?

According to the theories serving as their basis, the calculations differ in no small degree from one another. Nevertheless, scientists agree in holding that not only the mass, but also the density, pressure, and temperature of matter must have reached absolutely enormous proportions, as can be seen from the recent work of A. Unsöld, director of the Observatory at Kiel (*"Kernphysik und Kosmologie,"* in the *Zeitschrift für Astrophysik,* XXIVB, [1948], 278–305). Only under such conditions can we explain the formation of heavy nuclei and their relative frequency in the periodic system of the elements.

Rightly, on the other hand, does the mind in its eagerness for truth insist on asking how matter reached this state, which is so unlike anything found in our own everyday experience, and it also wants to know what went before it. In vain would we seek an answer in natural science, which declares honestly that it finds itself face to face with an insoluble enigma. It is true that such a question would demand too much of natural science as such. But it is also certain that the human mind trained in philosophical meditation penetrates more deeply into this problem.

It is undeniable that when a mind enlightened and enriched with modern scientific knowledge weighs this problem calmly, it feels drawn to break through the circle of completely independent or autochthonous matter, whether uncreated or self-created, and to ascend to a creating Spirit. With the same clear and critical look with which it examines and passes judgment on facts, it perceives and recognizes the work of creative omnipotence, whose power, set in motion by the mighty *Fiat* pronounced billions of years ago by the Creating Spirit, spread out over the universe, calling into existence with a gesture of generous love matter bursting with energy. In fact, it would seem that present-day science, with one sweeping step back across millions of centuries, has succeeded in bearing witness to that primordial *Fiat lux* uttered at the moment when, along with matter, there burst forth from nothing a sea of light and radiation, while the particles of chemical elements split and formed into millions of galaxies.

It is quite true that the facts established up to the present time are not an absolute proof of creation in time, as are the proofs drawn from metaphysics and Revelation in what concerns simple creation, or those founded on Revelation if there be question of creation in time. The pertinent facts of the natural sciences, to which We have referred, and the theories founded on them, are in need of further development and proof before they can provide a sure foundation for arguments which, of themselves, are outside the proper sphere of the natural sciences.

(*Continued on page 165*)

"A United Front Against True Science"

"The philosophical importance of the new Soviet cosmogonic theories, based on consequent materialism, looms even larger in the light of the recent pronouncements of Pope Pius XII. For the first time, in fact, in the history of the Catholic Church, a sovereign Pontiff, abandoning all attempts for conciliation with Genesis, throws his support behind certain cosmogonic hypotheses, which, even if they, too, postulate a creation of kinds ('expanding universe' of Lemaître, Milne, and others], are far removed from the creation story of the Scriptures. . . . This new position of the Pope . . . seems to announce a closer united front of diverse idealist philosophies, against materialism and true science."

—Paul Labérenne, in *La Pensée*
the Marxist, pro-communist French magazine introducing an article by O. I. Schmidt on Soviet cosmogony

Science and Politics in Britain: The Paymaster-General

By EDMUND DEWS

Those who are interested in seeing scientific knowledge brought to bear on national policy have followed the career of Lord Cherwell with great interest. An intimate friend and counsellor of Churchill's, he was his constant adviser during the war years. With the return of the Conservative party to power, he has been reappointed Paymaster-General and, what is new, given a post in the Cabinet.

The present article, discussing Lord Cherwell's role in the organization of scientific research in Britain is part of a larger study of the historical development of the British government's scientific policy which Mr. Dews, an historian and meteorologist, is preparing as a Rhodes scholar at Oxford. At the Bikini tests in 1946 he was in charge of the upper air analysis section of the Weather Central.

If the British Government under Mr. Churchill makes any important changes in the policy and organization of its scientific research establishments, it will not be because of great doctrinal differences between the Conservative and the Labor parties. Both parties are committed to the support of research on a large scale; and the development of British scientific policy, and the growth of government scientific institutions, have followed a steady course through many alternations of government since the war of 1914–18. Changes there soon may be, however, and these are best explained—or, at any rate, discussed—in relation to the remarkable friendship between the Prime Minister and Lord Cherwell (formerly Mr. Frederick Lindemann), professor of physics and head of the Clarendon Laboratory, Oxford.

"It is an open secret," said the Conservative Chancellor of the Exchequer in a recent debate in the House of Commons, "well known to all who know how the mind of the Prime Minister works, that for many years he has in emergencies—many of them of grave national importance—relied on the personal help and advice . . ." of Lord Cherwell.

It is difficult to place Cherwell in any familiar category in British politics. He is not really a politician, certainly not in any sense a party leader entitled by political prestige to high office in the government. His one adventure into competitive politics ended disastrously, when he appeared at the bottom of the poll in a 1937 by-election for one of the university seats in the House of Commons. Cherwell's peerage, his post as Paymaster-General during the war, and his reappointment to that post in the new Conservative government, are due to his unique position as confidant and adviser to the Prime Minister. Personal friends and advisers of Prime Ministers are not entirely unknown in Britain, but the strength and importance of the relationship between Churchill and Cherwell recalls the roles played by Col. House and Harry Hopkins. Although suggestive, this analogy is inadequate. Cherwell is much more than a very intelligent loyal friend, available to run important errands and ready with shrewd comment and relaxing conversation.

In addition to high academic achievements, Cherwell has two qualities which make him an invaluable assistant to the Prime Minister. One is his passionate interest in the application of scientific techniques to purposes of national defense, of which the outstanding example was his concern for improved British anti-aircraft preparations in the critical years just before 1939. The other quality is perhaps even more important. Cherwell has a remarkable flair for thinking quantitatively on all subjects and for presenting the results of statistical analysis for rapid and intelligible use by the Prime Minister and members of the government. Both of these qualities have been gratefully recorded by Churchill in his *History of the Second World War*. But the extent to which these qualities were organized, or better, institutionalized, for the Prime Minister's use, is not generally known. The best account is given by the economist G. D. A. MacDougall in an essay on the Prime Minister's Statistical Section.[1]

Cherwell's Wartime Services

Soon after Churchill went to the the Admiralty he asked Cherwell, who had been advising him privately, to join his organization and form a small statistical branch. Cherwell collected a group of very young, brilliant men from the universities, mainly economists, a scientist or two, not much more than a dozen in all, and began the routine analysis and interpretation of data bearing on Admiralty operations. In May 1940 Churchill became Prime Minister, and Cherwell's statistical branch continued to assist him, with greatly enlarged scope, and became known as the Prime Minister's Statistical Section. After the appointment of Cherwell to the post of Paymaster-General, in December 1942, it was sometimes known as the Office of the Paymaster-General, but it remained in every respect the Prime Minister's personal statistical service, acting through Cherwell as his personal adviser.

[1] D. N. Chester (editor), *Lessons of the British War Economy* (London, 1951), pp. 58–68.

What sort of work did the section do? Apparently, it dealt with every topic in which Churchill and Cherwell were interested and about which conclusions could be drawn from statistics. It functioned on its own initiative as well as at the Prime Minister's request, and the reports submitted to him unusually contained a quantitative argument in favor of some proposed course of action; they were not simply "for information." The section prepared charts and data for Churchill's conferences with President Roosevelt and made frequent suggestions concerning general economic policy. About a third of its reports were directly concerned with scientific matters, especially the technical details of new weapons and their development, production, and use. In short, it may be described as a sort of high-level civilian counterpart of the operational research sections which were simultaneously growing up and proving their effectiveness in various British military and naval commands, and which are connected with the names of Rowe, Blackett, Bernal, Zuckerman, and other distinguished scientists.[2]

The personal nature of this arrangement cannot be too much emphasized. It was, says MacDougall, the crux of the matter. The effectiveness of the arrangement depended upon the way the mind of the Prime Minister worked and the facility with which the Paymaster-General catered to his needs. Its justification was the justification for any part of the Prime Minister's personal staff which enabled him to do his work better.

[2] See J. G. Crowther and R. Whiddington, *Science at War* (London, H. M. Stationery Office, 1947).

Role of Paymaster-General

In theory, however, the position was somewhat different, and this has led to misunderstanding. According to constitutional convention, the Paymaster-General is not on the personal staff of the Prime Minister; he is a member of the government, a minor officer of state connected with the Treasury, in former times of some importance, but now bereft of almost all departmental duties. Often the post is treated as equivalent to a Ministry without Portfolio, and is usually filled by a peer, useful for representing the government in the House of Lords. During the war constitutional niceties could be ignored, and there was no objection to the arrangement by which the Paymaster-General, who was outside the War Cabinet, served actually as personal assistant to the Prime Minister. In the new Conservative government, however, Cherwell has not only been appointed to his old post as Paymaster-General, but he has been given membership of the Cabinet itself, to the exclusion of such important ministers as those of Supply, Education, and Agriculture and Fisheries, and the ministers most directly associated with the nationalized industries.

An adequate treatment of this topic would lead us far outside the scope of the present discussion, but a few points can be made. The Prime Minister is one member of a plural executive body of which the members are jointly responsible for government policy and individually responsible for the work of their departments. The inner circle of this executive is the Cabinet, with whom the Prime Minister regularly consults. The composition of the Cabinet is not fixed by law, and the Prime Minister has considerable choice in selecting the men and departments to be included. In the nineteenth century, before the great increase in the scope of government activities, nearly every important department could be represented in the Cabinet; in fact, the Cabinet *was* the department heads, and coordination of their work was achieved at Cabinet meetings under the chairmanship of the Prime Minister, who was only first among equals.

Something like this is still true, but important modifications have occurred and are now taking place. The number of major departments has increased to nearly double the number which can conveniently be included in the Cabinet (the present Cabinet contains seventeen members), and the power and prestige of the Prime Minister has increased relative to his colleagues. A major problem of administration has arisen in ensuring consistency in policy and coordination of work throughout so many departments. The Labor government, under Mr. Attlee, favored a system of Cabinet committees which grouped together related departments and frequently consulted with ministers outside the Cabinet. While not abandoning the committee system, Churchill's government is conspicuous for the number of ministers it contains who are charged only or mainly with coordinating the activities of ministers outside the Cabinet.

Now where in all this does the Paymaster-General take his place? If he is only a personal adviser and confidant of the Prime Minister, does he really deserve a post in the Cabinet, and what constitutional precedent is there for it? If he is to be a departmental minister, what is his department? And if he is to be a coordinating minister, which ministries does he coordinate? Such questions as these have been asked by the Opposition

"It Would Have Been Worth Millions"

". . . The House will realise that it is often exceedingly difficult in this country, where we do not keep police records as they do abroad, to prove to the satisfaction of a quasi-legal tribunal that a man is not a good security risk. Unless this can be done, such a man remains at his post. Even if he is not immediately concerned with most secret matters, he is bound to know—and can certainly find out—a good deal about what is going on in other sections where secrecy is absolutely vital. . . . All this, of course, could be avoided in a more flexible organization. People would be given contracts with a 'break' clause. It would be possible to get rid of them without any stated reason on payment of six months' or a year's salary. Naturally, their salaries would have to be higher. But surely it would be well worth it. If we could have prevented Fuchs giving the information to Russia which has enabled them so quickly to make atomic bombs, it would have been worth paying many millions of pounds. . . ."

—Lord Cherwell, in a statement
before the House of Lords, July 5, 1951

and the press, and it cannot be said that they have yet been clearly and unequivocally answered. The informality and flexibility of the Cabinet system is such that this is not, however, altogether surprising. The full implications of Cherwell's appointment have probably not been revealed because they have not yet been worked out.

Nature of Position

One thing is clear, however, and this is that the appointment is of Churchill's, not of Cherwell's doing. Cherwell did not put himself forward in the keen but concealed competition for Cabinet office. Although willing to serve the Prime Minister as an independent adviser, he was persuaded only with difficulty to accept his new post. This is interesting. Cherwell's reluctance is consistent with the traditional notion of an academic scientist seeking to avoid political entanglement. But is it consistent with the view, developed during the war, of the proper relation of the operational research scientist to his executive? This view is that the usefulness of the scientist is curtailed by keeping him as a back-room adviser, and that his greatest contribution is forthcoming only when he is placed in the executive in a position of high authority, where he is free to define his own problems and urge his own solutions in matters of policy as well as technique. It is not certain, of course, that operational research is the best description of Cherwell's work. But if it is, his appointment to the Cabinet might have been powerfully defended on these grounds.

When the new Cabinet was announced, there was a tendency to try to explain Cherwell's appointment by analogy with the new coordinating ministers. "It is believed," stated the *Times* (London) on 31 October 1951, "that he will be responsible for the coordination of scientific research and development." This explanation still has some currency on both sides of the Atlantic, although the events of the last five months show that it has little substance. Those who hoped for the establishment of a Ministry of Science have again been disappointed.[3]

[3] A central Ministry of Science was proposed in the Report of the influential Haldane Committee on the Machinery of Government, Command Paper 9230 (London; H. M. Stationery Office, 1918). Similar proposals were rejected by Churchill's wartime government, and later by the Attlee government.

Provisions for Scientific Research

At this point it will be helpful to describe briefly the structure of British government arrangements for scientific research. Here there is a useful distinction between "civil" and "defense" research.[4] Defense research includes all research, basic and applied, directed to the eventual production and procurement of equipment for the fighting services. In practice it also includes all or nearly all research which for reasons of national safety must be kept secret. With the exception of some research done by the Admiralty, defense research is the direct responsibility of the Minister of Supply. For convenience, because of its close relation to military aircraft research, much research into civil aircraft design is also carried on under the Minister of Supply; and, by the Atomic Energy Act, 1946, Parliament placed responsibility for the promotion and control of atomic energy in his hands. The atomic energy research laboratories at Harwell and elsewhere in Britain are part of the Ministry's research establishments.

On the other hand, the structure of civil research is extremely diffuse. As the importance and utility of research have been recognized by successive governments, it has been accepted as a "service" indispensable to the long-term effectiveness of nearly every major government department. There are numerous research committees, scientific advisory and research officers, research teams, laboratories, and well-established research branches attached to various ministries.[5] Some, such as the Post Office, Colonial Office, and the ministries of Works, and Agriculture and Fisheries, have a large research budget and employ many scientists, and the ministries associated with the nationalized industries are rapidly developing their own research branches. In addition to all this, which is called "departmental" research (and is generally in the field of applied science), there is a major concentration of research activity under the Lord President of the Council, who is the minister (now in the Cabinet) responsible for the three research councils: The Department of Scientific and Industrial Research (DSIR), the Medical Research Council, and the Agricultural Research Council. The work of these three includes a great deal of what can be fairly called "basic" or "fundamental" research. The DSIR provides the government's link with the cooperative industrial research associations, supported partly by it, but mainly by industry.

[4] University research is done only to a very small extent under contract with government departments. Large sums, however, are voted annually by Parliament for the support of the universities, on the advice of an independent committee of experts on which scientists are well represented. Sometimes part of these grants is earmarked by the Treasury for scientific purposes, but the larger proportion is a block grant for the general support of each university, although in fact much of it, at university discretion, is applied to scientific research. See University Grants Committee, *Annual Reports* (London: H. M. Stationery Office).

The Coordinating Councils

Under the Labor government an attempt was made to achieve improved coordination within and between the civil and defense research programs. For this purpose two new large coordinating committees were established in 1947, at the same time as the reorganization of the ministries of Defense and Supply. These are the Advisory Council on Scientific Policy (ACSP) and the Defense Research Policy Committee (DRPC).

The ACSP was given very inclusive terms of reference: "To advise the Lord President of the Council in the exercise of his responsibility for the formulation and execution of government scientific policy. It is clear that under the Labor government, the responsibility of the Lord President was interpreted as including nearly the whole field of civil research. The an-

[5] The best published description of these bodies is contained in the White Paper on Scientific Research and Development (*Government Scientific Organization in the Civilian Field* [London: H. M. Stationery Office, 1951]). Also useful is the Third Report from the Select Committee on Estimates, *Expenditure on Research and Development*, House of Commons Sessional Paper 131–1 of 1946–47 (London: H. M. Stationery Office, 1947).

nual reports of the ACSP deal with such problems as Britain's requirements for scientific manpower, the principles of organization of research for the nationalized industries, and the coordination of research activities carried on by the research councils and the departmental research establishments. It is significant, therefore, that no diminution in the Lord President's scientific responsibilities has been announced; on the contrary, his responsibility for the research councils has been confirmed by the new government.

Similar but not parallel to the ACSP is the DRPC. While the ACSP contains independent representatives from the Royal Society, the universities, and industry, the DRPC is made up entirely of government scientists, supply officers, and representatives of the fighting services. Although it is formally responsible for advising the Minister of Defense on aspects of defense research, it is perhaps more properly regarded as part of the hierarchy of closely interconnected committees which emanate from the Cabinet Committee on Defense. The function of the DRPC would seem to be the coordination of aim and effort between the Ministry of Defense, which, with the service ministers and chiefs of staff, establishes research policy, and the Ministry of Supply, which actually carries out research and development and procures equipment. Coordination between the ACSP and the DRPC has been achieved through personal links between the two, primarily by their both having had the same chairman, Sir Henry Tizard.

The retirement of Sir Henry Tizard at the end of March 1952 offered the obvious opportunity to bring these bodies under the Paymaster-General, or to replace them by other coordinating machinery subordinate to him. Nothing like this has been done. The government seems to have accepted both the ACSP and the DRPC as part of its permanent scientific arrangements, and the Lord President has already announced (February 1952) that Tizard's successor as chairman of the ACSP will be Professor A. R. Todd, the Cambridge chemist. It would be going too far, however, to conclude from what has just been said that the Paymaster-General will make no contribution at all to the coordination of government research. Coordination on the highest level is the job of the Cabinet, and the opinion of the only trained scientist in the Cabinet is sure to be influential whenever questions of scientific organization arise—or whenever he chooses to bring them up.

Research and Development

Apart from any coordinating function, there is the possibility that Cherwell may acquire some departmental responsibility for research, particularly atomic research. On 15 November 1951, the Prime Minister announced in the House of Commons that the Paymaster-General would be responsible for advising *him* on atomic energy questions. This is probably the basis of the press reports which in various ways attribute to Cherwell responsibility for British atomic research. It is necessary to distinguish here between "responsibility" in its general and its parliamentary usage. The Prime Minister's advisers are responsible to him, but they may or may not be responsible, in the strict sense, to Parliament. It is just this distinction which makes the new role of the Paymaster-General so difficult to analyze, and which has caused confusion in Parliament itself.

The direct Parliamentary responsibility for atomic research—that is, in practice, answerability to the House of Commons for the policy and administration of the government's atomic energy establishments—was given to the Minister of Supply by the Atomic Energy Act, 1946. Since this is a statutory duty laid on the minister, it cannot be transferred except by legislation or by Order in Council subject to resolution in Parliament. Consistently with this requirement, the Prime Minister stated also on November 15 that he was considering what adjustments should be made in the statutory responsibility of the Minister of Supply. He assured Mr. Strauss (formerly Minister of Supply in the Labor government) that unless there were an amending Act, there would be no change in the minister's responsibility for atomic energy, but that pending legislation,[6] "an arrangement" could be made without difficulty—presumably defining the sphere of activity of the Paymaster-General. So far as the present Cabinet is concerned, there should indeed be little difficulty, for Cherwell is Churchill's intimate friend, and the Minister of Supply (Mr. Sandys) is Churchill's son-in-law. It is easy to see grave difficulties in principle, however, in any arrangement whereby responsibility is left with the Minister of Supply, but real authority is transferred to the Paymaster-General.

The situation is made more piquant by the fact that Cherwell is known to favor removing atomic research entirely from the control of the Minister of Supply. Last summer he moved a resolution in the House of Lords regretting the slow progress made in producing a bomb, and urging the (Labor) government to transfer research from the Ministry of Supply to "a special organization more flexible than the normal civil service system" which should be "under the direct control of the head of the government." Without going into much detail, he appeared to approve of the principle of organization of the United States Atomic Energy Commission, and he suggested for Britain a semi-independent research corporation on this model or on the model of some of the British nationalized industries.

In the absence of more complete information from the Prime Minister, further speculation about the work and responsibilities of the Paymaster-General is likely to be fruitless. Without any question it is an important thing for science that a distinguished academic scientist should be included in the British Cabinet. The results should be felt not only in Britain but also in America, directly as well as indirectly, for we can expect Lord Cherwell to appear again in the role of international negotiator. On the other hand, as the present Chancellor of the Exchequer has warned, it is unwise to invest the Paymaster-General with powers which he does not have.

Laplace, too, was a minister of state but we do not remember him for that. Despite his political ambitions, he did not succeed in adapting the "method of infinitesimals" to the better working of the French Ministry of the Interior. Napoleon dismissed him after six weeks. Cherwell, however, has now established a very considerable success. Partly it is his own. How much is it due to the chance of having a Churchill as Prime Minister? The important question, for natural and political scientists alike, is whether the present appointment can transcend the limits of personal relationship on which it is based, and lead to the establishment of a permanent arrangement by which scientific knowledge and method can be brought directly to bear on the work of the Cabinet.

[6] Up to the present time (20 March 1952) no amending legislation has been introduced nor relevant Order in Council published.

Senator Vandenberg on Atomic Energy

The early months of this year saw the publication of the private papers of another American, influential in the shaping of foreign policy in the last quarter-century—Senator Arthur H. Vandenberg. The Senator's diary is the chief source of information for the story presented in this volume[1] *edited by his son, with the collaboration of Joe Alex Morris. The book records Vandenberg's career from the time of America's entry into the war, with the Japanese attack on Pearl Harbor, until the Senator's death in April 1951.*

Vandenberg was active both in the domestic management of atomic energy and in the plans for its international control. He served as a member of the Joint Committee on Atomic Energy from its inception until a year before his death.

The publication of these papers reveals yet another American statesman's views on the many events in which American atomic scientists have participated. Perhaps the most interesting portion to those familiar with the history of atomic energy legislation and the debates on international control is the section dealing with the sharing of atomic information with Britain. With the permission of the Houghton Mifflin Company, publishers of the book, we reprint this section in full, together with extracts from other chapters dealing with the Senator's part in the atomic energy program.

THE FIRST ATOMIC BOMBS AUGUST 1945

THROUGHOUT the Senate debate on the United Nations Charter, Senator Vandenberg repeatedly emphasized that the world must avoid a third great conflict because new weapons of war would virtually desolate the earth. Then, as the Allied drive against Japan reached its climax, his words were underlined with fire by the explosion of the first atomic bomb over Hiroshima on August 6, 1945. . . .

With the end of the war, top-secret information about development of the atomic bomb was generally made available to the newspapers, which previously had never mentioned the vast project on which America's greatest scientists had been engaged high in the New Mexican mountains at Los Alamos and elsewhere. The project had been under Army control. . . . Tight security regulations had been set up; scientific workers had been "compartmentalized" or confined to specific phases of the work, and only a few men had knowledge of the overall picture. But, with the war ended, there was a movement for quick return to peacetime procedure. Some scientists wanted to exchange atomic information with colleagues all over the world. Some military men wanted to keep the whole program under close Army control. Half a dozen bills were introduced in Congress aimed at such varied objectives as outright military control of atomic energy and complete abandonment of nuclear fission for military purposes. . . .

In the next few weeks a real Congressional snarl threatened on the subject because various committees were claiming jurisdiction over atomic legislation. . . . In an effort to resolve this situation, Vandenberg introduced a Concurrent Resolution in mid-September to create a Joint Congressional Committee of six Senators and six Representatives to handle atomic problems. . . .

September 20, 1945.—A lot of bills of one kind or another have been introduced. . . . They have gone to various committees. No one committee could possibly have clear jurisdiction over a question of such all-embracing import. Soon we shall have rivalry between these committees and a rush to get somebody's pet bill reported. This is very dangerous business. To meet this situation I introduced a Concurrent Resolution last week to provide a Joint Congressional Committee . . . to take jurisdiction over the entire question of the development, control, and use of atomic energy. My obvious purpose is to concentrate this terrific responsibility in one place where it can be handled in effective cooperation with the President. . . . The President told our special committee this morning that he thinks my Resolution presents the right way to handle the legislative end of this desperately important matter.

Despite the President's attitude, the Congress had a difficult time agreeing on procedure, and it was only after a prolonged Senate debate that a special Senate Committee on Atomic Energy was formed with eleven members, headed by Senator Brien McMahon of Connecticut, whose Resolution for such action was finally accepted. Vandenberg and other high-ranking members of committees dealing with military, foreign relations and related matters were appointed to the com-

[1] Arthur H. Vandenberg, Jr., and Joe Alex Morris, (editors), *The Private Papers of Senator Vandenberg* (New York: Houghton Mifflin Co., 1952). pp. xxii+599. $5.00.

mittee. These senators went back to school for a while to learn the rudiments of atomic science from General Groves, Dr. Edward U. Condon of the Bureau of Standards, and other scientists. They also visited atomic energy projects, before they settled down to try to map out a national legislative policy on the subject. . . .

PROBLEMS OF INTERNATIONAL CONTROL

December 10, 1945.— Secretary of State Byrnes this afternoon called in the special Committee of Foreign Relations—also three members of the Atom Bomb Committee—and talked with us about his Moscow trip. He said he proposed to suggest an exchange of atom scientists and scientific information with Russia as his first step; then that Russia join us in setting up an Atomic Commission under the United Nations Organization to carry on. His plan was a great shock to the entire committee. Everyone spoke earnestly.

We agree that Russia can work out this atom science in perhaps two years; but we are unanimously opposed to hastening the day unless and until there is absolute and effective agreement for world-wide inspection and control. This is the crux. We want to banish atom bombs from the earth. But it is impossible unless Russia agrees to a total exchange of information, instead of hermetically sealing herself behind "iron curtains."

We are opposed to giving any of the atomic secrets away unless and until the Soviets are prepared to be "policed" by UNO in respect to this prohibition. We consider an "exchange" of scientists and scientific information as sheer appeasement because Russia has nothing to "exchange." It was our general opinion that we made little impression on the Secretary.

As a result the special Senate Committee [on Atomic Energy] met immediately and unanimously voted to ask an immediate audience with the President. . . .

Stages in Disclosure

December 11, 1945.—The President received our full committee this morning. We stated our case and disclosed our fears. The President said he agreed with us, but that he was sure we had misunderstood the Secretary. I asked him if it would be proper for us to see the "directive" he had given Secretary Byrnes for his Moscow errand. He readily produced it and read it to us.

To our amazement we found that the "directive" would fully justify the precise sort of plan which Byrnes told us he intends to pursue. It listed four consecutive steps (with "inspection" and "control" last); and it then specifically asserted that our government considers it quite proper to proceed "a step at a time." We pointed this out to the President—and showed him that, under the "directive," it would be possible for the Secretary to prematurely give away, while in Moscow, at least half of all our "trading stock" when we seek essential controls. It was respectfully suggested that the "directive" be immediately changed by radio (Byrnes already was en route). We do not know whether this was done or not because, for some inscrutable reason, the President seemed to fail to grasp our point in respect to the "directive."

In any event we have made the record —and we shall hold the Executive Department responsible It is our unanimous opinion that the Byrnes formula must be *stopped.*

Appointment to U.N. General Assembly

On December 21, 1945, Mr. Truman had advised the Senator of his appointment as a United States delegate to the General Assembly meeting in London on January 10. . . . Vandenberg replied:

"You will readily understand that these tight limitations (regarding the delegation's discretionary powers) might commit me to obligations which I would be unwilling to assume, as, for instance, in the control of atomic energy. I anticipate no such crisis. But in such unexpected event, you have my assurance that your instructions to me as a delegate will continue paramount, and I shall resign rather than run counter to these instructions. . . .

U.S. Proposals for International Control

On December 27 . . . Byrnes, Bevin, and Molotov completed their labors at Moscow and issued a communiqué that outlined a four-point term of reference on atomic energy for the proposed U.N. atomic control commission. . . .

"I very nearly resigned [from the London delegation] . . . when the Moscow Communiqué came out because I could not possibly subscribe to what it said about the atom bomb," the Senator wrote. "I am unwilling to endorse any atomic disclosures to Russia unless and until we have adequate and dependable methods of international inspection and control which will guarantee the world that atomic weapons are never made again anywhere. The Moscow Communiqué sounds like one more typical American 'give away' on this subject."

Vandenberg didn't resign. . . .
He wrote to Senator McMahon:

January 2, 1946.—Being unable to get in touch with . . . members of the Committee before leaving, I wish to leave this record with you. . . . I know of the desperately deep interest which you all have in the international phase of atomic controls. . . . When we called upon the President recently I believe we made it clear that we believe this problem must be handled as a whole. . . . Our basic demand throughout was for adequate international inspection and control as the indispensable first step at all times. . . . The President agreed . . .except that he thought we misconstrued his directive [to Byrnes].

"Is the Wit of Man Competent?"

"I am frank to say that I do not yet know what the answer is to the awful problem which we have brought upon ourselves. It seems perfectly clear that we could not hope to monopolize this secret very long. It also seems clear that atomic energy will have to be put under ultimate international control. This would obviously require a complete and absolute right of world-wide inspection and information. It would be unthinkable, for example, for us to voluntarily permit Russia to take the secret of atomic energy behind its blackout curtain to do with it whatever Moscow pleases. On the other hand, even if we can get a complete and adequate international inspection, we shall still be at the mercy of any brutal aggressor who may suddenly decide to use the atomic bomb against us. So the prospectus is appalling under *any* circumstances and under *any* controls which we might conjecture. I sometimes wonder whether the wit of man is competent to deal with this murderous discovery."

—Senator Vandenberg
in a letter to his family pastor
October 26, 1945

Last Wednesday the first news of the Moscow Communiqué came through. It listed four stages for the work of the UNO Commission—"disclosure" *first* and total "security" *last*. Then it said that "the work of the Commission should proceed by separate stages" and that each "stage" should be completed before the next is undertaken. It seemed to me that this could be read in no other way than that the precise thing is to happen [to] which both our Committee and the Foreign Relations Committee are so earnestly opposed. I felt that I had no right to go to London, as a Senate spokesman, under any such instructions to promote any such objective.

I immediately presented the matter to Acting Secretary Acheson who, in turn, 'phoned the President in Missouri. It was arranged that we should meet immediately upon the President's return. We did meet on Thursday. Meanwhile, they had communicated with the Secretary en route home. As a result, I was advised that the Communiqué should not be read as seemed unavoidable upon its face; that it does not intend to take the "stages" in the order recited in the Communiqué; that the whole is to be read together; and that complete and adequate "security" must be part of each "stage" of disclosure. This latter is the key. *Each stage of disclosure must be accompanied by adequate arrangements for security.* The President authorized the statement along this line which I issued from the White House *after* it had been approved by Acting Secretary Acheson and prepared in his office.

Under the circumstances, I feel that I can now proceed to London without impairing my obligation to my Senate colleagues. Indeed, the circumstances *now* probably *demand* that I go. . . .

Later, after a conference with Vandenberg, Byrnes announced that Britain, the Soviets, and the United States had agreed that security regulations were to govern all stages of the atomic commission's activities and that the end product would be referred to the American Congress for approval.

DOMESTIC CONTROL: MILITARY VS. CIVILIAN

During March and early April of 1946 . . . the struggle to develop an atomic control bill—later to be known as the McMahon Bill—was nearing an end. The legislation provided for a strict government monopoly over fissionable materials, with licensing arrangements to encourage participation of private concerns in peacetime application of the new force. For senators geared to the principle of private enterprise and opposed to government monopoly it was a new departure but, as Vandenberg pointed out, so was atomic energy. He wrote to a constituent:

April 18, 1946.—I agree that it [the McMahon Bill] involves a degree of centralized governmental control which is out of step with all of our essential principles in respect to free enterprise. But I am frank to say that I can see no other answer for the time being which will protect the national security. The use of atomic energy for destructive purposes is the greatest hazard that ever threatened civilization in general and the American way of life in particular. Until we can develop adequate and dependable safeguards against this *destructive* use of atomic energy, I can see no possible justification for *any* latitudes in the control of fissionable material. This inevitably means government monopoly at the source of fissionable material. Our "secret" in respect to atomic bombs probably will not be a "secret" for more than five years; but it seems to me that during these five years we must keep it to ourselves through every possible precaution so that we can exercise maximum international pressure for effective and dependable international control. Again this seems unavoidable to require a government monopoly in respect to the sources and production of fissionable material. . . .

Your final paragraph suggests that this problem is so serious that no "precipitate" action should be taken in connection with it. I am sure there is nothing "precipitate" about [the bill]. It comes from a special select Senate Committee which has been constantly at work night and day for five months upon every phase and impact of the problem. Those of us who wrote the bill are jealous advocates of free enterprise. We would not have put atomic energy in a strait jacket (so far as basic material is concerned) if there were *any* alternative. But I am sure you will agree that considerations of national security *must* come first when we are dealing with this life-and-death problem.

The Vandenberg Amendment

The Senator's intense interest in protecting the secrets of atomic energy . . . led him into a new controversy that had nation-wide repercussions. It began when he suggested an amendment to the bill aimed at assuring the military a full voice in the American atomic energy development program. Accepted on March 12 by the Committee, with only Senator McMahon voting against it, the amendment read:

There shall be a military liaison board appointed by the President composed of representatives of the Departments of War and Navy, in such number as the President may determine. The commission shall advise and consult with the board on all atomic-energy matters which the board deems to relate to the common defense and security. The board shall have full opportunity to acquaint itself with all matters before the commission. The board shall have authority to make written recommendations to the commission from time to time as it may deem appropriate. If the board at any time concludes that any action or proposed action of the commission, or failure to act by the commission, is inimical to the common defense and security the board may appeal such actions or proposed actions of the commission to the President, whose decision shall be final.

"A Condition and Not a Theory"

"If it were possible to keep this secret in our own possession indefinitely, this would be my first and emphatic choice because we know that America will not use this devastating weapon for aggressive purposes. There are other nations unfortunately which do not deserve this trust. But there is no use in fooling ourselves nor in running away from the facts. . . . Britain and Canada have been our atomic partners and are in possession of [atomic] information. . . . All of our scientists, without exception, testify that any other nation can successfully pursue this scientific secret in the course of the next few years and produce atomic bombs of their own whether we like it or not. Therefore, we confront a condition and not a theory. . . . Our proper course is clear. It is our task to develop through the United Nations Organization a system of complete world-wide inspection which shall guarantee to civilization that no nation including ourselves shall use atomic energy for the construction of weapons of war. I know of no other *logical* answer. . . ."

—Senator Vandenberg
in a letter dated
November 13, 1945

McMahon's opposition was based on belief that the amendment undermined the principle of civilian control, although at one time he had supported placing both the Secretaries of Army and Navy on the over-all control commission. Many American scientists, still raw-nerved from their experiences with General Groves's wartime program, arose in loud protest. The bitterest critic of all . . . was Henry A. Wallace, then Secretary of Commerce. . . .

McMahon claimed the Vandenberg amendment would enable the military to "look into every single telephone call, every single file, every single action" the commission would take. It might be civilian control, the Connecticut senator argued, but it would be such control only with the military looking over the civilian's shoulders and ever able to take over.

Scientists in Washington

The scientists in newly formed organizations descended on Washington; a large portion of the press, usually in Vandenberg's corner, came out swinging; and an alarming cross-cut of the public joined in the growing opposition. Vandenberg wrote:

March 14, 1946.—[A] little tempest in a teapot . . . has blown up during the last forty-eight hours regarding atomic energy. There is a perfectly legitimate demand in the country (especially among scientists and educators) that final peacetime control of atomic energy should rest in civilian hands. In other words, the peacetime emphasis in respect to atomic energy should be transferred from military uses to civilian uses. I totally agree. But! I do not agree that in the present state of world affairs the Army and the Navy should be totally excluded from consultation when they deem the national security to be involved. It is a parallel conception to say that I want atomic bombs outlawed everywhere and forever and I shall make every maximum effort to this end through UNO. But until we get adequate international arrangements for dependable inspection and control, I do not want to internationalize *our* atomic bombs.

The trouble with those who have been most violently urging civilian control is that they all but ignore the national security factor. Of course, they are supported in this viewpoint by every Communist and every fellow-traveller and every parlor pink in the country, because these latter groups would like to make our national security as insecure as possible. I offered a proposal in our . . . Committee to compose these two differing views on a rational and practical basis. I have proposed that our basic Atomic Energy Commission shall be composed exclusively of civilians. Then I have proposed the creation of a Military Liaison Committee . . . which shall have the right to know what is going on in the Civilian Commission and the right to call the attention of the President to any contemplated action . . . which the Army and Navy think might be dangerous to national security. In such an event, the President (himself a civilian) immediately makes the final decision. . . . The only power given to the Army and Navy is to say "stop, look, and listen.". . . . I cannot imagine how even the most elementary consideration of national security could be protected more modestly and more moderately.

Hogness' Part in Compromise

But Vandenberg could convince neither the scientists, the press, nor McMahon. . . . Something had to be done, and Vandenberg did it. He called on Dr. Thorfin R. Hogness, a University of Chicago chemist who had been intimately a part of the atomic project and in whom he had confidence. He told Hogness that he was willing that the scientists "write [their] own ticket" as long as it fell foursquare within the purpose of assuring proper liaison between the military and the ultimate civilian authority, and that the military phases of atomic energy were not to be neglected in an aura of wishful thinking about a brave, new postwar world. Hogness worked as middleman between Eisenhower for the military, the scientists, and Vandenberg. The distilled result was a new version of the now famous military clause . . . [in which] the Military Committee's authority was narrowed down to "military applications" of atomic energy alone, not to the far broader field of "common defense and security." The military group, also, was placed directly under the control of the War and Navy Secretaries, reporting only through them and with their concurrence to the President.

Vandenberg happily announced that the new version met the "common objective" of all concerned. The Senate Committee unanimously approved the redraft; the military and the scientists were well pleased, and the fight was over.

COOPERATION WITH BRITAIN

Vandenberg's intense interest in atomic energy and his position as chairman of the Foreign Relations Committee brought him into touch with important negotiations in the period of 1947–49 when there was top-level behind-the-scenes controversy over atomic agreements with Great Britain and Canada. The secret wartime atomic arrangements on which President Roosevelt and Prime Minister Churchill had agreed, at Quebec and Hyde Park meetings, were not entirely clear in the official records, and it was not until 1947 that some high officials acquired detailed knowledge of the agreements. It should be pointed out that knowledge of the agreements was not communicated to the Senate by President Roosevelt. The agreements established a Combined Policy Committee, representing the United States, Britain, and Canada, to regulate matters of mutual interest and concern in the highly secret field of atomic energy. The United States had three members on the committee, Britain had two, and Canada one. Several changes were made in the American membership on the committee in the years immediately after the war.

Agreement with British on Use of Bomb

Sometime in the late spring or early summer of 1947, however, Vandenberg and Hickenlooper were startled to discover that Mr. Roosevelt had agreed that the United States would not use the atomic bomb against any other country without the consent of the British. The Senators promptly got in touch with President Truman, Secretary of State Marshall, and Defense Secretary James Forrestal to express their surprise and opposition to any such arrangement and to urge the necessity of an immediate rectification of the agreement. The Senators also raised objections to the fact that large amounts of atomic material were being

"In peacetime we cannot drive science into its laboratories with bayonets."

—Senator Vandenberg
defending civilian control
of atomic energy, in a
Senate speech, April 3, 1947

stored in the British Isles, where it might fall into Russian hands in event of an outbreak of war in Europe and at a time when it was required for the U.S. atomic program.

This situation led to a meeting at the Pentagon on November 16, 1947, with the two Senators, Forrestal, and Undersecretary of State Lovett. They discussed the Roosevelt-Churchill agreements as well as later agreements which, according to the Senator's papers, provided, among other things, for: (1) Sharing of information on atomic development between the United States and Britain and cooperation in atomic development; (2) Problems related to the sharing of uranium ore from the Belgian Congo; (3) Agreement of the United States and Britain not to use the atomic bomb against each other; and not to use it against any other country unless both Britain and the United States agreed.

(*The Forrestal Diaries*, page 338, indicate that Forrestal first heard of the Quebec agreement from Hickenlooper, presumably including the arrangement requiring consent of the British before the bomb could be used. From other sources it was known that the data concerning the atomic agreements had been gathered together by the State Department in two or three months prior to the November 16th Pentagon meeting.)

Lovett, the report on the Pentagon meeting discloses, told the Senators and Forrestal that the information exchange with the British was to cover certain scientific fields, in the opinion of State Department experts, but never to serve as authority for giving the British full information on all phases of atomic energy. The British, Lovett was described as saying, were becoming restless at the failure to obtain a complete exchange of information. And Lovett reportedly said that since the end of the shooting war Britain had received a substantial portion of the Congo ores.

Vandenberg told the conferees that he and Hickenlooper had become aware of the prohibition in the late spring or early summer of 1947 and that he (Vandenberg) had discussed it with President Truman, Secretary of State Marshall, and Forrestal. These discussions, Vandenberg said, dealt with both the prohibition on using the bomb and storage of large amounts of unused atomic material in Britain. Hickenlooper, the report of the Pentagon meeting shows, recalled that he had written Marshall earlier expressing the greatest dissatisfaction with the current situation, urging that it be rectified at once, and stating that he would be unable to support American financial aid to Britain unless this was accomplished.

Vandenberg declared that he thought the Hyde Park and Quebec agreements were "astounding" and "unthinkable," and that he felt a tremendous responsibility as chairman of the Senate Foreign Relations Committee in this regard. He said that failure to revamp the agreements would have a disastrous effect on Congressional consideration of the Marshall Plan, at that time in a formative stage. Both Senators, noting that discussions with the British and Canadians on revising the wartime agreements were to begin shortly, said that a satisfactory conclusion must be reached before final action on the Marshall Plan program.

Removal of Restriction on Bomb's Use: 1948

In January, 1948, agreement was reached with Britain and Canada in Washington to remove the restriction on use of the bomb. As a result, the final decision for use of the bomb was left in the hands of the President, as specified by American control legislation. The Washington meeting also assured the United States of more adequate ore supplies and clarified the general areas of atomic energy information exchange.

Exchange of Information—Production of Plutonium

The problem of information exchange was revived later in 1948, however, when Vandenberg and Hickenlooper learned from AEC Commissioner Lewis L. Strauss that Dr. Cyril Smith, an Atomic Energy Commission scientist, had gone to Britain with a letter of authority from the AEC to discuss several matters, including the "metallurgy of plutonium" with the British. Both Senators believed that such a discussion went beyond the authority of the Commission and they took up the question on August 12, 1949, with Forrestal, Dr. Vannevar Bush, chairman of the Joint Research and Development Board, and Donald F. Carpenter, chairman of the Military Liaison Committee established in the Atomic Energy Act of 1946. The meeting, in Forrestal's office, produced another surprise for the Senators, who had been led to believe that the British atomic energy activities were concentrated on industrial power rather than weapons.

Vandenberg's papers said that a distinct difference of understanding was expressed as to the aims of the British atomic energy program. Vandenberg and Hickenlooper insisted that it had been their understanding that British efforts were aimed in the direction of use of atomic energy for industrial power and other nonmilitary purposes. Dr. Bush reported that, for a considerable period of time, the British had been emphasizing weapons production.

Hickenlooper told the conferees, according to the report, that he had just been informed that the Atomic Energy Commission had outlined areas of discussions with the British which entailed disclosures of information far in excess of what he and Vandenberg had understood were embraced in the new American-British-Canadian agreement, and that such new discussions would involve exchange of information on "basic metallurgy of plutonium," which he considered to be solely bomb and atomic weapon material. Such an information exchange, Hickenlooper contended, was beyond the legal authority of the Atomic Energy Commission, beyond any possible interpretation of the tripartite agreement on information exchange, and that it embraced weapons information possessed exclusively by the U.S. at that time. He added that possession of such information by the British could be a major danger to the United States and a "major target" for Russia. Dr. Bush was then quoted as saying that at that time plutonium had to be considered as exclusively weapons material and that information concerning its metallurgy had to be considered as weapons information.

"During this time I know—and I am very dogmatic about it—that I am best serving my country when I provide the tightest possible 'public control' of atomic energy in the United States."

—Senator Vandenberg
in a letter
February 17, 1947

As a result of this discussion, the visit of Dr. Smith to Britain to discuss the metallurgy of plutonium suddenly became a matter of vital importance. (*The Forrestal Diaries*, page 471, state that Forrestal told Sumner T. Pike, acting chairman of the Atomic Energy Commission, that the Defense Department "regarded the conveyance of this information as extremely serious and to be halted if humanly possible.") The conferees in Forrestal's office were described by the report as expressing "genuine concern," and AEC Commissioner Strauss, acting through Pike, attempted to reach Smith in London in order to rescind his authority for discussions with the British. The following day, Vandenberg and Hickenlooper were informed that Strauss, whose original concern was now shared by Dr. Bush and Secretary Forrestal, after cables and transatlantic calls from himself and Pike, had been able to reach Smith and cancel his authority to discuss the metallurgy of plutonium.

Blair House Conference, July 1949

At still another high-level conference on July 14, 1949, Vandenberg and Hickenlooper went into the broad subject of atomic cooperation with Great Britain at a Blair House meeting over which President Truman presided. Also present were: other Congressional Atomic Energy Committee members, Vice-President Barkley, Secretary of State Acheson, Defense Secretary Louis Johnson, who had succeeded Forrestal, General Dwight D. Eisenhower, temporarily recalled to Washington as head of the Joint Chiefs of Staff, Atomic Commission Chairman Lilienthal, and several others.

According to the record of the conference, Mr. Truman presided and took part in the conversation, but it should be pointed out that generally the spokesmen for the Administration viewpoint in this instance were the current American members of the Combined Policy Committee. They were Acheson, Johnson, and Lilienthal. The President opened up the evening discussion by relating that the current Anglo-American-Canadian allocation agreement would expire in December and that it was essential to continued operation of the United States atomic program that uninterrupted supplies of uranium from the Congo be assured. The Administration viewpoint was that while the British had been original partners in the atomic program, they now were denied access to some information, including all information dealing with atomic weapon making, and that the British were insisting that a complete partnership was required by the world situation. Mr. Truman reportedly told the conferees that he had reached agreement with the American members of the C.P.C. for an approach to the British which would assure them a full partnership including sharing the "know how" on weapon making. The position of the Administration, the report stated, was that Anglo-American friendship required such action; the British had able scientific personnel and were ahead of the U.S. in some scientific and chemical fields; that it was only a matter of time until the British proceeding independently developed the bomb; and that Britain's close relations with the Belgians gave her an influential voice in distribution of Belgian Congo ores.

For these reasons, it was stated that the Administration proposed: an atomic partnership with Britain and Canada; an agreement for pooling of information; that the U.S. seek agreement with the U.K. to send all but a limited quantity of source materials to the U.S. for processing and storage; that British and Canadian scientists work in the U.S. with their American colleagues; and that an unspecified number of component weapon parts be stored by the U.S. in the British Isles.

Vandenberg's Views on Anglo-American Cooperation

Vandenberg, according to the record of the meeting, stated that he was not prepared to agree to any such an undertaking. He stated that the United States during and after the war had repeatedly and continuously extended its aid to Britain, and without any overwhelming degree of cooperation in return. Vandenberg stated he thought that Britain should reciprocate by permitting the United States to assume full responsibility for atomic weapons production and retain its "know how." Furthermore, the Senator pointed out that the concept of Atlantic Pact defense was based upon avoidance of unnecessary duplication of defense functions by the allied nations plus a specialization of endeavors for which the individual member-states were particularly equipped. In atomic energy, Vandenberg said, the United States was particularly equipped to carry the prime responsibility. Furthermore, he maintained that the United States was in a position to morally and honorably insist that Britain cooperate in assuring her a proper allocation of the Belgian Congo ores and that Britain should do this without demanding full information disclosures. A discussion also took place regarding the legality of such a full partnership in light of the restrictions placed on administration of the United States atomic program by Congress.

The question of exchanging information with Britain and Canada in various fields of atomic energy, of course, was not settled at the meeting. It remained a subject of discussion between the three participating governments and between the United States executive branch and Congress.

RUSSIAN ATOMIC EXPLOSION

September 23, 1949.—. . . We had a meeting of the Atomic Energy Committee in secret this morning (and a very solemn one) regarding the Russian development—it's far from certain precisely what the Russians have other than the man-made means of exploding nuclear fission with vast resultant radio reaction. It was [a fairly short time], in our own case, after our original experimental explosion before we tried any actual bomb. Then it's many months before there can be real bomb production in minimum quantities. But the Russians have had [many thousands of] men at work on the job and the benefit of many top notch German scientists whom they virtually kidnapped. In any event, this is now a different world. The new problems are appalling. Where do we go from here and what do we do about it?

THE HYDROGEN BOMB JANUARY 1950

Late the same month [January 1950] he [Vandenberg] resigned from the Joint Congressional Atomic Energy Committee because he was unable to take an active part in its work. . . . He suggested through the press on February 1 [1950] that the President notify the United Nations that we were ready to abandon the new hydrogen superbomb project as soon as Russia permitted effective international control of atomic energy. But, for the most part, Vandenberg made no attempt to "lecture" his Senate colleagues from the sanctuary of a sickbed where he would be more or less immune to counterattack, and he made only one entry in his diary—the last he was to make—during 1950.

The Federalists in Europe

By HENRY USBORNE

The author of the following article is a British Labor Member of Parliament and secretary of the Parliamentary Group for World Government in the House of Commons. The Group, whose chairman is Arthur Henderson (son of the Arthur Henderson who was Foreign Secretary in the 1931 Labor Government), is one of the largest unofficial groups in the Commons. In March of this year there were 56 Members of Parliament in the organization (out of a total of 625 members in the House of Commons).

THOSE of us in Europe who advocate closer political integration between the nations, and who share the view that this essential unity can only be successfully achieved through the mechanism of supranational political federation, seem often to find ourselves at loggerheads. Let us try and get clear how and why our differences arise.

They arise, I suspect, out of our respective fundamental approaches to the first principles involved in the problem. According to the differing angle of this first approach one's subsequent conclusions will also vary.

World Federalist's Beliefs

The world federalist, staggered by the futility and horror of war, analyzes its causes and comes to the conclusion that it springs directly or indirectly from the absence of global government. To his mind peace is a by-product of government, and war and international suspicion and the absence of world government are all synonymous terms. While humanity arbitrarily divides itself into threescore and more of separate sovereign nations, each afflicted by its own Foreign Office, each regarding itself as the center of the universe, and each arming furiously to protect or to enforce its own peculiar interpretation of what it thinks is justice, our world remains a warring jungle of lawless and rapacious robber barons. Each national baron commands his private gang of obedient gunmen and asserts that he provides freedom and security thereby. Globally, it adds up to sheer anarchy.

With the arrival of our twentieth-century scientific age, the time has now arrived when these baron nations and their gunmen should be disarmed and the business of providing protection and security for the common peoples taken from the hands of the nations and their rulers, and transferred to a properly constituted representative world legislature. The time is overdue for this logical last step which will conclude the historic process of integration which began when the primitive family gave way to a tribal association, which continued when, in its turn, the tribe gave way to the province, the canton, and the nation, and will conclude when the nations are merged into the World State.

At this point in the analysis a single question arises. How many more steps are there or ought there to be from the foot of the historical ladder, which is the primitive family, to the top, which is the World State? The world federalists answer this question by asserting that there is only one step left to take. In our view the next and immediate task is to attempt the construction of the constitutional framework of the World State in order to start *at once* this final task of getting all the nations of the world to come into it.

Necessary Conclusions

Now, if you hold these views, certain conclusions will inexorably flow from your premise. They are:

a) The constitution of the federation you are seeking to create must be of such a type that once the initial and specified quorum of nations has ratified it, the nucleus world state can then immediately be brought into being and, thereafter, without alteration to its basic constitution, this nucleus of the founder-nations can be enlarged by the addition of any other nations in the world which see fit, or can be persuaded to see fit, to enter. If and when they enter, exactly similar terms will apply to them as are already applied by the constitution to the existing participating nations of the union.

b) Obviously no federal constitution which is at present in use will be suitable for the world union thus envisaged. A great variety of different nations of vastly differing sizes, economic potentialities, and standards of life and culture are to be encouraged to amalgamate. And no one can foretell in what order or over how many years or decades this process of continual integration into the nuclear parent union will continue.

c) Clearly, the task of designing an appropriate workable global federal constitution to meet the needs will be immensely difficult. No one supposes it to be easy. But we do not believe it is beyond the wit of man. In any event, since we cannot presently tell which nations are likely to decide to join initially, and since, if they do not join initially, we still want them in, it seems to us both unnecessary and un-

wise to consider the chickens that will join it before the eggs which are the clauses of the constitution (the terms of membership) are hatched. The fundamental fact is that no attempt has yet been made by a responsible group of politicians to solve this problem of world-constitution writing. Incidentally, we are open-minded as to whether the effort should be made formally diplomatically to amend the Charter of the U.N. or whether it would be wiser to tackle the problem outside the scope of that organization. The cardinal point is that some attempt ought to be initiated; we may leave the manner and the procedure of its doing until a more general desire for its accomplishment has first been generated.

Aims of Regional Federalists

One may now define the differences between the World and the European or Regional federalists. The former do not deny that within the framework of the World State it is probable that the European peoples will be prudent to join as a single homogeneous political entity. But whether Europe, as an area, can in fact be thus fully united prior to the moment it is able to enter the larger framework is a different, and an acutely complex, issue. In any event, it seems clear that once the global federation is in being, European or any other regional integration will be infinitely easier to achieve.

On the other hand, the kind of constitution which would be required for a purely European Union now would obviously be quite inappropriate if this same union were to be regarded as the nucleus of the World State. We are here dealing with two distinct and different entities. There is a case to be made for both; but it is a different case, and the issues are different.

If the supporters of Atlantic Union, as we understand is the case, are seeking to convert the existing confederal association based on NATO into a federal one, the same remarks made above about European Union are, *mutatis mutandis,* relevant to a union of the NATO nations. In neither is it proposed to employ a global type of federal constitution which would work as well for the founder nations as it would if all or any of the other nations in the world subsequently decided to come into it.

There should not, of course, be any real conflict between the world federalists and those other federalists who are more immediately concerned with the unity of smaller and, to them, more pressing agglomerations. The different concepts are not mutually antagonistic.

Advantages in Federation

I don't think anyone believes that within a World State, if ever such a thing comes to exist, the present geographical and political delineations which currently mark off the world's nations will, or even should, necessarily survive. Nation-states, for the most part, are accidents of history, and hardly any of them represent sensible, functional entities. Their boundaries, by all the dictates of reason, ought in many places to be redrawn; and many should be eliminated altogether. But can this sort of thing, this remapping of the world's surface into twentieth-century political and administrative areas, be done before the pressure of war has been considerably lessened, or until the danger of its divisive force has been finally eradicated from a substantial group of the nations? It would seem to be highly improbable.

At least two-thirds of the population of this globe now lives perpetually in squalor, hunger, and poverty. The other third enjoys an enormously higher standard of living. Whether this inequality is itself the economic cause of war, or not, is beside the point. The fact is that in this inventive age this manifest injustice is both unnecessary and intolerable; and bold steps must soon be taken to eradicate it. Almost everyone is agreed on that. But it seems to me that there may be only one satisfactory way by which such a task can be accomplished. A World Mutual Aid Fund administered by a world political authority will have to be created which can raise its revenue mainly by taxation. Under this authority and out of this fund large-scale economic development schemes could be initiated and financed. It will not, it seems, suffice for nations voluntarily to contribute or even to decide for themselves what the size of their contribution ought to be. For such an arrangement, as was UNRRA, would be hopelessly unstable. Nor, as at present constituted, is the U.N. an effective institution through which to create the required authority. The World Development Authority will need to be a Department of State of a supranational government if it is to succeed.

Example of TVA

The history of the TVA indicates why this must be so. The TVA would not have been possible had the areas it attempted to develop been parts of separate sovereign states. It was only because the citizens of the states involved were under the direct jurisdiction of the federal government of Washington and because the U.S. Supreme Court could settle the repeated disputes over the constitutionality of its activity that the TVA survived and prospered. It is surely therefore reasonable to anticipate that similar development schemes, this time on a vastly larger scale, will encounter similar constitutional difficulties, and fair to conclude that world courts with the power and the authority to adjudicate the disputes are equally a prerequisite of success. Without these world courts and without a world parliament, the most laudable ambitions of men and of nations are almost bound to be abortive.

Effect of Legal Sovereignty

And lastly, the world federalist, in his capacity as such, is not willing to be drawn into arguments about the cold war, about East-West tensions or the apportionment of the blame for the shortcomings of the U.N. All these things, we think, are subsidiary to the main issue. So long as the powerful nations of the world remain legally sovereign and continue to maintain command of their own armed forces, then disputes, disagreements, and warlike acts are bound to result. It is pointless to complain of

(*Continued on page 165*)

Russian Science Symposium:

VI

Statistics in the Soviet Union

By ***STUART A. RICE***

Another branch of Soviet science affected, at least in its philosophy, by Marxist dogma is the science of statistics. Mr. Rice, assistant director for Statistical Standards in the U.S. Bureau of the Budget, tells in this article why he believes that the distortion of statistics by party-line philosophy is more apparent in theoretical interpretation than in Soviet practice.

THE FATE of the science of genetics in the Soviet Union has more recently been inflicted upon statistical theory. The two developments are not unrelated, and the second may even be regarded as a sequel to the first. There is no doubt of the subordination of statistical conceptions to the party line. The important question that I cannot answer with the same assurance is whether or how the imposition of party doctrines upon statistical theory has affected statistical *practice*. Because of evidence that was obviously unavailable to Professor J. R. Kline when he wrote for this symposium ("Soviet Mathematics," *Bulletin*, February 1952), I am inclined to invert his views concerning the scientific integrity of Soviet statistical theory and practice, respectively. I feel pessimistic where he is assured, but I am less confident than he of the prevalence of "bias" at the points he assumes it. However, I have no reason to question his interpretations concerning the present state of Soviet mathematics and the independence of mathematicians.

In the following quotation from his article, Kline may be thinking of "statistical theory" in a limited, wholly mathematical sense:

> There is no evidence whatsoever of a party line in mathematics similar to that which one finds in the biological work of Soviet scientists. . . . True, *when statistics are applied to economic and social questions, then bias is often introduced* . . . in that the data from which statistical conclusions are drawn are selected in such a manner that results favorable to the communistic way of life are exhibited. However, in statistical theory, where great advances have been made by one of the world's leading mathematicians, Kholmogorov, *there is absolutely no evidence of any motive other than the search of truth for the sake of truth.* [My italics.]

Statistics and Propaganda

In speaking of bias in social and economic statistics, Kline is probably thinking of the claims, aided by statistical manipulation, that are put forth in other countries concerning Soviet economic progress. Their undoubted exaggeration, to which I return below, does not necessarily reflect, however, upon the essential integrity of the Soviet statistical system. That is, the collection and analysis of statistical data are one thing, and their propagandistic presentation—a form of art in which lies of varying dimensions may enter—is quite another. If Kline means that the basic statistical data of the Soviet Union are "selected in such a manner that results favorable to the communistic way of life are exhibited" to the Soviet strategists and planners themselves, then I find the grounds for my opinion on the question to be conflicting.

Reliability of Basic Data

Reasons for assuming bias in the basic economic data of the USSR and a consequent self-delusion among its leaders are persuasively presented by Margaret Mead and L. H. Haimson in the Rand Corporation study *Soviet Attitudes toward Authority*. Mead cites various types of evidence to illustrate "Bolshevik willingness to accept or to fabricate token events" (pp. 44 ff.). Referring to tendencies to report overfulfilment of plans or production quotas—for example, asserting "the readiness of the machines in a Machine Tractor Station . . . [when] half of the tractors may break down within a week," she remarks:

> Although bureaucratic conditions are particularly favorable to the tendency to believe what it is most comfortable to believe, this . . . goes to special lengths in the Soviet Union. As so many of the reports are concerned with real events—the amount of grain harvested, the number of trucks turned out by a factory—false reporting has very real repercussions in actuality and so can be branded as sabotage. But as failure to overfulfil a plan

may also be regarded as sabotage, the possibility of such repercussion hardly discourages the practice of inaccurate reporting.

A variant of the motivations reported by Mead as leading to exaggerations and errors in reporting is that explained by Haimson (p. 121): Confronting extreme forms of "industrial disorganization and division of authority," and yet "expected to meet very high production quotas," the party representatives, managers, and administrators of economic activities may respond in either of two fashions. They may turn on each other, submitting one another to "inhuman pressures"—an extreme form, it would appear, of the process known elsewhere in milder circumstances as "passing the buck." Alternatively, they may "stand by one another in falsifying production figures, in attributing fictitious reasons to accidents and breakdowns," etc., a solution characterized in the party lexicon as engaging in "family relations."

As Haimson is quick to point out, retribution is not far behind when the second type of response is resorted to. Hence, over a period of time, I should expect to find a continued strain toward an increasing accuracy of reporting.

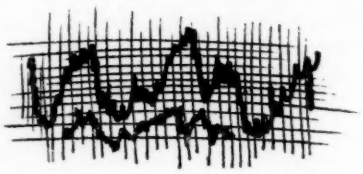
Nor would the interests of propaganda impair the information utilized by state officials themselves. The USSR follows a studied policy of statistical secrecy. Its basic statistical data are seldom "exhibited" to anyone, foreign or Russian, outside of a limited official circle. They are "state secrets"—"security information" in our terms—which it may be a serious criminal offense to disseminate. According to decrees of June 8 and 9, 1947, divulgence of some kinds of data that would circulate freely in democratic countries, by those to whom ". . . information is entrusted or who may obtain the information by virtue of their official position is punishable by imprisonment from 8 to 12 years in a corrective labor camp."

If information is classified as an "especially guarded state secret," its disclosure may incur "death by shooting or outlawing as an enemy of the working people, jointly with deprivation of the citizenship of an Union republic, and, thereby, of the Union of the SSRs and exiling for all time beyond the frontiers of the Union of the SSRs and confiscation of property."

These horrendous penalties are set forth in the first chapter, "Crime Against the State," Special Part, article 58, section 6, of the *Penal Code of the Russian Soviet Federative Socialist Republic*.

The importance of securing good statistical data for state purposes has been stressed in Soviet exegesis. N. G. Michajlov quotes Lenin as saying that "Socio-economic statistics is one of the most powerful implements of social understanding. . . ." Michajlov continues:

> Statistics in the USSR makes use of every form of statistical data, particularly whole systems of accounting introduced by the socialist state and technical operational records in socialist industries and offices. In the USSR statistics is inseparable from the whole system of official records and of control of production and distribution.
>
> Comrade Stalin placed unusual emphasis on the primary tasks of statistics in the organization of socialist records. The most important task of statistics in the USSR is the compiling and submission to the government of authentic data showing the course of fulfilment of national plans, the growth of the socialist political economy and culture, the status of the material resources in the national economy and their exploitation, etc.[1]



Information for Control

I think it safe to infer that the rulers of the Soviet Union have at their disposal reasonably accurate statistics concerning the economy of their nation. I doubt whether, in carrying out their domestic economic and social programs, they would long permit themselves to be misled by highly erroneous information. Following his service as our Ambassador to the USSR, 1933–36, Mr. William C. Bullitt told me that the director of the first Soviet census had been rewarded for his work by execution. However, the top echelon of the Central Statistical Administration in Moscow has now held office for a considerable number of years, and this implies success in supplying accurate information for national control purposes.

Consistent with this conclusion is the evidence in an article "On the Reliability of Soviet Statistics," by Lynn Turgeon, in the *Review of Economics and Statistics* for February 1952. By way of introduction the author says: "There has been a considerable amount of agreement that data obtained from official pronouncements and statistical publications have meaning and significance. At least it is widely held that the Russians do not engage in outright falsification." He compares the figures in (1) "a standard source of pre-war statistical data on the USSR used by Western economists to date," i.e., the report by Voznesensky, chairman of the State Planning Commission, to the 18th All-Union Conference of the Communist party on the annual plan for 1941; and (2) a "classified" statistical compilation captured by German forces during World War II and subsequently secured by Western intelligence personnel. Turgeon finds the disagreements between the published Soviet figures for 1941 and the "more detailed *confidential* plan for the same year" to be "very minor and . . . reasonably attributed to the territorial changes that took place in 1940." The close correspondence seems to strengthen the opinion that "however misleading may be the way in which Soviet statistics are presented, they are not based on sheer invention, but have meaning and significance."

Bias in Statistics

It is true that biases in certain Soviet statistical series have developed with the passage of time and been allowed to continue uncorrected for an extended period. Distortions of this type have sometimes developed in the statistics of other countries. The most conspicuous of these in the Soviet Union have been the upward biases in indexes of industrial production and national income resulting from the continued use of 1926–27 prices as a base. That base has now been replaced by a new system employing "1952 permanent prices" according to a special dispatch from Moscow appearing in the *New York Times* of March 13, 1952.

The *Times* article points out that "Soviet economists long have realized the inadequacies of the old index system and had criticized it even before World War II." However, "Western economists believe that the Soviet regime maintained the deficient meth-

[1] "Against Deformation of the Marxist-Leninist Doctrine of Statistics," *Statistical Bulletin* XIII, Nos. 8–9 (Prague, Oct. 15, 1950) translation.

od for as long as possible because the exaggerated results played a key role in Soviet propaganda about the 'advantages' of the Soviet system."

To recapitulate, it is my opinion that if we were able to penetrate the Soviet statistical "blackout" and examine the organization and products of the Soviet statistical system, we would find much that was praiseworthy from a technical standpoint, assuming the tasks which the system had been assigned. These tasks would be a species of social accounting, pointing up the successes and failures of the state-controlled economy. I would also expect to find practices and techniques that were open to technical criticism, as in any other country.

Soviet Theory of Statistics

However, if we were to turn from our technical appraisals to an examination of the health of statistics as a branch of science, we would find our subject subordinated to a party line that rejects some of the established tenets of science. We would find these tenets replaced by revealed dogma. We would encounter official insistence upon motivations "other than the search of truth for the sake of truth." This fact would probably be denied, but with the specious explanation that basic truth has already been discovered and that the legitimate tasks for statistics are only those of elaboration and illustration.

My preceding statements are derived from a source only recently available in the United States, namely, a translation of the first number of *Vestnik Statistiki* (January–February 1950), organ of the Central Statistical Administration of the Council of Ministers of the USSR, published in Moscow. It contains the summary record of a two-day "Conference on Methodology" at the offices of the Administration. It was at this conference that the party line concerning statistical science was pronounced and the repentences of heretics were received. A brief summary of the argument will indicate its general purport. A fuller résumé and commentary are contained in my paper contributed to the International Statistical Conferences in New Delhi last December and preprinted with permission in the *Review of Economics and Statistics* for February 1952. I hope that a complete translation in English of the summary record may soon be made available to other students.

EDITOR'S NOTE—

This article on statistics is the sixth in a series the *Bulletin* has published on the state of Soviet science today.

The series opened in February, and will be continued in later issues.

Recent Conference on Statistical Theory

The conference opened up the theme, presented by V. N. Starovskiy, chief of the Central Statistical Administration, that "harmful bourgeois influences and anti-Marxist distortion in Soviet statistical science and literature hamper its development." The root of the evil is "the formal mathematics school of thought" which "considers statistics a universal science for the study of nature and society based ultimately on the mathematical law of large numbers and not on Marxist-Leninist theory."

V. A. Sobol, of Starovskiy's staff, reported at length upon "the theoretical basis of statistics." Statistics, he said, is a *social* science. Its tasks and the theoretical foundation of its methods are formulated in the works of Lenin and Stalin. Lenin taught that statistics "should *illustrate* [my italics] *what has been established*" by [Marxian] analysis of social and economic relationships. The end of statistics is to serve as a tool for building a communist society. "Only statistics based on historical materialism and [communist] political economy is scientific statistics." The view of statistics as a universal science, comprehending both nature and society, is "fundamentally in conflict with Marxism. Marx, Engels, Lenin, and Stalin have always emphasized the uniqueness of social phenomena and their basic difference from natural phenomena. . . ."

The real basis for the "conflict" and its bearing upon theories of heredity seem to appear in some of the statements with which Sobol continued:

> The fallacy of turning statistics into a universal science was clearly revealed in Nemchinov's comments on Academician Lysenko's biological thesis report at the 6 August 1948 session of the All-Union Academy of Agricultural Sciences. Nemchinov said that from his point of view as a statistician, "the chromosome theory of heredity was part of the gold reserves of the science of mankind." In his concluding remarks Lysenko made the following very correct and important observation, which has direct bearing on statistics:
>
> "On the whole, according to the followers of Morgan, living nature is a chaos of random, separate phenomena without any essential connection or orderliness. Chance governs all.
>
> "Not being in a position to show that living nature is orderly, the Morganists have to resort to the theory of probability and, not understanding the exact nature of biological processes, they turn biology into bare statistics. It is not surprising that foreign statisticians—Galton, Pearson, and now Fisher and Wright—are also considered the founders of Mendelism-Morganism. It is probably for the same reason that Nemchinov stated here that to him, as a statistician, the chromosome theory easily fits in with his concepts."
>
> This clearly shows that there are no grounds for turning statistics into a universal science.

If I follow it, the argument behind this "demonstration" is about as follows: Experimental evidence concerning heredity (a non-"social" field) employs statistics. But the theory to which the evidence leads is false. Therefore, the use of statistics for such experiments was improper. Therefore, statistics cannot be used to analyze any variable phenomena of nature. Therefore, it is not a universal science.

A moment of silent prayer might be recommended at this point; or perhaps of silent meditation upon the implications of these doctrines: *Statistics can be used only to illustrate what communist analysis has established. Statistics is inapplicable to non-social phenomena. Statistical theory and practice "are based on the teachings of Marx, Engels, Lenin, and Stalin." They must be "purged of the remnants of bourgeois ideas and the influences of bourgeois ideology."*

These dogmas must be taken seriously and they raise important questions: they seem to have the effect, for example, of banning any place in Soviet science for Heisenberg's "principle of indeterminacy." They seem to outlaw studies of variable phenomena in nature wherever found—physics and chemistry no less than biology. Will they ultimately bring a downfall in the communist structure? Or will the well-nigh incredible capacity of the Soviet mind simultaneously to hold contradictory beliefs make it possible to work with tools which are declared not to exist?

Unwarranted Assumptions

I fear that the reaction of non-communist scholars to developments affecting science, including statistics, in the Soviet Union is somewhat naïve. A belief in the freedom of inquiry, in the obligation of intellectual integrity,

is deeply imbedded in democratic traditions. In spite of all we learn about communist philosophy, we still make unwarranted assumptions concerning the possibilities of freedom for science in Soviet lands. I think, for example, that naïveté crept into the editor's prefatory note to Professor Kline's article when he termed the destruction of genetics as "strange and disturbing." Disturbing, certainly, but not strange; unless, perhaps, it should seem difficult to discern the particular ends of Soviet policy that are served by Lysenkoism.

Again, an element of naïveté is suggested by efforts like that of Dr. Lonsdale ("Impressions from a Recent Moscow Visit," *Bulletin,* March 1952) to break down "the barriers of misunderstanding and suspicion between us." If her efforts refer to cultural differences that separate groups of scientists as such, there is much to be hoped from contacts such as hers. On the other hand, it would be naïve to assume that the basic differences between Science and Soviet "science" are resolvable into "misunderstanding and suspicion" between individuals or groups. Dr. Lonsdale probably does not believe this, but her narrative permits that interpretation.

Expediency in Scientific Thought

There can be no doubt, in my opinion, that only considerations of *expediency* can protect any branch of science in the Soviet Union from the fate of genetics and statistics. As phrased by Nathan Leites in his recent Rand Corporation study of *The Operational Code of the Politburo,* "The fundamental law [of communist behavior] is to do all that enhances the power of the party, the great and only instrument in the realization of communism, the great and only good." For example, if a party line has not been established for pure mathematics, a possibility which Professor Kline finds difficult to imagine, I think we must believe this to be only because up till now a party line for mathematics has not been expedient.

Soviet Logic

We cannot reassure ourselves with the thought that such a step would be a logical absurdity. Miss Mead (*op. cit.,* page 38) refers to the "habitual expectation [in Russian communist thought] that contradictions will coexist." I can illustrate this with a recent personal experience: At an international meeting of "experts," the questions presented were of such a character that it was to the advantage of the USSR to appear as a poverty-stricken nation. The Soviet participant, a distinguished scholar, told of the war's great destruction, still unrepaired, which had left his country in a devastated and helpless economic condition. His statement followed my own, in which I quoted numerous official assertions that the physical plant of the Soviet Union had fully recovered from the war and had increased its productive capacity more rapidly than that of any other nation. In reply to questions from other participants, the Soviet spokesman accepted the accuracy of my quotations but averred that "any reasonable-minded person would see that there is no inconsistency between the statements quoted and my own."

The Soviet view of logic, like its view of human nature, appears to be, in the words of Mead and her associates, "so very unfamiliar to Americans that only by the greatest attention can it be held in mind. . . . As consistency and sincerity are regarded by Americans as essential to integrity, and as both are lacking in the behavior of the Soviet leadership, there is a temptation to continue to apply American standards of judgment. . . . From the Bolshevik point of view the essential virtue consists in being so goal-oriented that no contradiction can arise between behavior demanded by changes in the Line and the individual behavior. . . ."

The authors, of course, are discussing party attitudes, not those of individuals who may be striving, against greater odds than we can easily imagine, to maintain the integrity of their particular professional discipline. Nevertheless, *Scientists are Human,* to employ the title of David Watson's book; and not even a martyr to the cause of science can erase from his mental outlook and behavior the distortions that result from the pressures upon him from the society of which he is a part.

What I am trying to say is that Soviet science and scientists are not and cannot be wholly free; at best they must live under a suspended sentence; but even if they were free, their attitudes and behavior would still reflect the influences of their own social milieu. They would therefore differ in their outlook from ourselves. It is a further task of Western scientists to distinguish so far as they find this possible, between the "misunderstandings and suspicions" that are removable and those which reflect the impervious dogmas of communistic religion in the Soviet state.

Correction

DR. IVAN D. LONDON, whose article on "Soviet Psychology and Psychiatry" appeared in the March issue of the *Bulletin,* is a member of the Russian Research Center at Harvard University. This identification of Dr. London was inadvertently omitted from the editorial note accompanying his article. We apologize to Dr. London and our readers.

"The human animal and his emotions change not much from age to age. He must change now, or he faces absolute and complete destruction, and maybe the insect age . . . will succeed him."

—PRESIDENT TRUMAN, in the book *Mr. President*

Book Reviews

Methods of Operations Research. By PHILIP M. MORSE and GEORGE E. KIMBALL. New York: The Technology Press of Massachusetts Institute of Technology and John Wiley and Sons, Inc., 1951. Pp. 158.

THE subject of operations research ("a scientific method of providing executive departments with a quantitative basis for decisions") has come to the attention of the public since the end of the war in popular articles describing a few of its more sensational accomplishments in countering enemy measures of war and improving the efficiency of our own. There has been interest aroused, therefore, for an authoritative, detailed exposition of the subject such as Morse and Kimball's. The authors are eminently qualified for the task, having been, respectively, director of Research Weapons System Evaluation Group of the Office of the Secretary of Defense, and deputy director, Operations Evaluation Group, United States Navy.

The material of the volume is divided into eight chapters, with an appendix of statistical tables of quantities useful in the types of analysis described, a bibliography (principally references to mathematical sources and prior popular expositions of operations research), and a fairly detailed index to the various technical problems and topics touched on in the text. The trend of the treatment is indicated in the titles of the chapters following the Introduction, namely: "Probability," "The Use of Measures of Effectiveness," "Strategical Kinematics," "Tactical Analysis," "Gunnery and Bombardment Problems," "Operational Experiments with Equipment and Tactics," and "Organizational and Procedural Problems." The principal examples given relate to practices in bombing and antisubmarine activities, maximum utilization of fire-power, etc.

The greatest weapon of the operations research worker, besides native sense and analytical power, is statistical analysis; his goal is to be able to delineate clearly to the executive the probable weights of various factors in problems requiring decision, and the possible eventualities in cases of various configurations or values of the unknowns. This may be quantitative for many cases only in the sense that numbers are used to express these things. Clear-cut answers are unfortunately usually the outcome only of trivial cases. The value of the volume to those with operational problems in other than the military field depends to a considerable extent on how able they are to transfer the approaches used and the mathematical expressions derived to corresponding nonmilitary situations, and to derive new viewpoints on approaches to problems from some of the otherwise trivial examples.

Following the fillip to the imagination given by the samples of operations research and their results presented in the popular accounts preceding the appearance of this book, it must be admitted that the book is somewhat disappointing. In part, this might be owing to a certain lack of freedom on the part of the authors—one feels the shadow of the censor once or twice. Perhaps it may be because the most striking examples have been exploited in the early accounts, leaving little new to recount. In part the feeling may also be due to the trivial nature of so many of the problems (and of the book's examples) when seen from the vantage point of the facts available to the student of operations research.

In part, for the merely curious technical reader, like the reviewer, it may lie in the anticipation error induced by the arguments of the authors, in the first chapter, that operations research is "a scientific method," with "a more or less definite methodology of attacking new problems and finding definite solutions," and not a branch of engineering. The argument used to make the latter distinction is that "the branches of engineering recognized at present are involved in the construction or production of equipment, whereas operations research is involved in its use," that "the engineer is the consultant to the builder, the producer of equipment, whereas the operations research worker is the consultant to the user of the equipment." It seems to the reviewer that such a distinction places the practitioners of chemical engineering and some of the electrical engineering specialties, to say nothing of the efficiency engineer mentioned earlier in the same paragraph, in an anomalous position.

—LEONARD I. KATZIN

Argonne National Laboratory

World Population and Future Resources. Proceedings of the Second Centennial Academic Conference of Northwestern University. Edited by PAUL K. HATT. New York: American Book Co., 1952. Pp. 262. $3.50.

IT WOULD be difficult, or even impossible, to bring together a set of more illustrious names appropriate to this subject in the United States. What has been assembled is a brief, nontechnical cross-section of the views of specialists covering population, food resources, material resources for industry, and energy resources.

Some of the highlights of this book will be familiar to *Bulletin* readers since a few of the contributions were carried in the April issue last year. The total program is more impressive because it provides answers for many of the commonsense questions which may arise affecting the odds in the contest between population and resource development. In this round, it was apparent that the Neo-Malthusians had the best of it. Those who would take an optimistic view of world development possibilities will have a difficult time averting the social catastrophes which are the natural outcome of the situations described by Kingsley Davis, J. J. Spengler, and Irene Taeuber. The nearest approach to a convincing reply is to be found in Farrington Daniels' assessment of the future of solar energy—but even this did not get directly to the point because it was not possible to talk about costs, or even the magnitude of unfulfilled human needs to be met. Because the discussion re-

volves around new science and new technology these aspects are well within the competence of scientists and engineers, yet hardly anything getting at costs or needs ever appears in print.

It is rather strange that systematic theories of world development should be so neglected by scientists, when cosmology and theories regarding the evolution of the universe engage the attention of hundreds of the most ingenious and most imaginative of them. Had there been in existence any alternative frameworks for world development, the Northwestern Conference would undoubtedly have organized its sessions along quite different lines. Is there something about the scientific professions and research organizations today which pulls the investigator's attention away from significant world-scale problems and directs his mind into channels which lead primarily to professional prestige? There is undoubtedly another book here for an enterprising sociologist.

—R. L. MEIER

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Nobel—The Man and His Prizes. Edited by the NOBEL FOUNDATION; written by H. SCHÜCK, R. SOHLMAN, A. OSTERLING, G. LILJESTRAND, A. WESTGREN, M. SIEGBAHN, A. SCHOU, N. K. STÄHLE. Norman, Oklahoma: University of Oklahoma Press, 1951. Pp. 620. $6.00.

THE Nobel Prizes have become such an accepted part of modern life that only occasionally does one stop to wonder about a period in which there were no such awards, and to muse on the manner in which they came to be, and the nature of the man whose name they bear. The book *Nobel* is in a real sense an historical document, for among its group of authors are some who knew Alfred Nobel, who were the original principals in the drama of the setting-up of the Nobel Institutes and the prizes which they award, and who have had experience in determining the recipients of the awards. As it is fifty years since the prizes were first granted, this constitutes almost a "last chance" to assemble a group of authors able to give such a first-hand story of the origin of the awards, and some of the behind-the-scenes drama of choosing the recipients. One cannot expect a more authoritative answer to questions on these points than is to be found in this volume in highly readable form. The problems in international relations involved, the elements of high finance and human intrigue, all help to give the story of the founding of the awards some of the flavor and interest of an adventure story.

The largest part of the book deals with the awarding institutions, their principles and methods of operation, and the awards granted in the five fields of the Prizes. Although a good deal is veiled in the polite secrecy necessarily covering the details of choices made between competing candidates for such high honors, the several authors vary individually in the strictness with which details are withheld. A great deal of enlightening and interesting background is the net result. The feeling of intellectual adventure on the international plane again cannot be avoided, in reviewing problems such as the granting of the Peace Prize over the period of two world wars, as well as the general problem of maintaining the highest standards of principle and intellectual honesty in granting international awards in times of international tension.

From all standpoints the authors and publishers of this volume have performed a real service.

—LEONARD I. KATZIN

Argonne National Laboratory

An International Bibliography on Atomic Energy; Vol. II, Scientific Aspects. New York: International Documents Service, Columbia University Press. Pp. 880. $10.

Unique in its scope, the *Bibliography* represents a comprehensive coverage of the technical literature in nuclear science for the past twenty-five years, the period during which many of the most significant discoveries in the field of atomic energy have been made. Since the volume is intended for technically-trained persons, popular accounts have generally been omitted.

Articles and books on the political, economic and social aspects of atomic energy were included in *Volume I* and the *Supplement to Volume I*, and are not therefore included in this second publication of the series.

Civil Defense in Modern War. By AUGUSTIN M. PRENTISS. New York: McGraw-Hill Book Co., 1951. Pp. 429. $6.00.

THIS book is a magnificent treatment of its subject; it could profitably be read from cover to cover by any person in civil defense administration.

The contribution of the book is *not* the specific set of solutions it offers for each problem (though every one of these is a good example of how that particular problem is treated somewhere), but rather in the setting up of a virtual roster of the innumerable problems themselves. It is rather hard to conceive of any general problem ever experienced or anticipated prior to the publication of this book not listed or discussed here. (Some details of Federal Sector Defense might be such a hard-won exception. Another might possibly be the detailed design of a stout cellar shelter to protect a building's occupants.)

A characteristic of higher civil defense training is that an individual becomes so immersed in his own field that it is almost impossible for him to realize how vast and detailed the areas are outside of his field. This book will help keep such higher personnel from losing sight of that fact. The sixth chapter, on bacterial agents, is especially useful in bringing out this point.

The matter-of-fact style does at times become rather oppressive. Under such circumstances, readers are apt to dwell only on italicized wordings, section headings, numbered headings, paragraph headings, etc., until they find a particularly arresting one. These are sufficiently well prepared, however, so that the reader does get the main points of the presentation and its flow of thought quite well from them.

A good deal of repetition is unavoidable but scarcely unprofitable, since most Civil Defense personnel find it necessary to run as they read. A chief teaching technique of the book might be termed "Assimilation by Repetition."

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BOOKS RECEIVED

After The A Bomb—Emergency Care in Atomic Warfare, edited by Charles F. Behrens, M.D. New York: Thomas Nelson & Sons, pp. 182, $2.50.

American Diplomacy 1900–1950, by George F. Kennan, Chicago, Illinois: University of Chicago Press (1951), pp. 146, $2.75.

Bibliography in an Age of Science, by Louis N. Ridenour, Ralph R. Shaw, and Albert G. Hill, Urbana, Illinois: University of Illinois Press (1951), pp. 90, $2.50.

Conflict of Loyalties, edited by R. M. MacIver, New York: Harper and Brothers (1952), pp. 150, $2.00.

The Crisis in Human Affairs, by J. G. Bennett, New York: Hermitage House (1951), pp. 239, $2.75.

In Defense of the National Interest, by Hans J. Morgenthau, New York: Alfred A. Knopf (1951), pp. 283, $3.50.

History of the Theories of Aether and Electricity, by Sir Edmund Wittaker, New York: Philosophical Library (1951), pp. 434, $12.00.

The Lobbyists, by Karl Schriftgiesser, Boston, Massachusetts: Little, Brown and Company (1951), pp. 297. $3.50.

National Defense and Higher Education, edited by Francis J. Brown, Washington, D.C.: Council on Education Studies (1951), pp. 121. (Series I—Reports of Committees and Conferences—No. 47.)

The Neglect of Science—Essays Addressed to Laymen, by F. E. Simon, Oxford, England: Basil Blackwell (1951), pp. 138, price 8s. 6d.

New Hopes for a Changing World, by Bertrand Russell, New York: Simon and Schuster (1951), pp. 213, $3.00.

998, by Edward Hyams, New York: Pantheon Press (1952), pp. 207, $2.75.

Nobel: The Man and His Prizes, by H. Schuck et al (edited by the Nobel Foundation), Norman, Oklahoma: University of Oklahoma Press (1950), pp. 620, $6.00.

Opportunities in Atomic Energy, by Karl D. Hartzell, Vocational Guidance Manuals, Inc., New York: Grosset and Dunlap (1951), pp. 143.

Our Atomic Heritage, by Arnold B. Grobman, Gainesville, Florida: University of Florida Press (1951), pp. 147, $2.95.

The Pattern of Responsibility, edited by McGeorge Bundy, Boston: Houghton-Mifflin Company (1951), pp. 309, $4.00.

Personality and Political Crisis, edited by Alfred H. Stanton, M.D., and Stewart E. Perry, Glencoe, Illinois: The Free Press (1951), pp. 260, $3.75.

The Planets: Their Origin and Development, by Harold C. Urey, New Haven: Yale University Press (1952), pp. . . ., $5.00.

Population on the Loose, by Elmer Pendell, New York: Wilfred Funk, Inc. (1951), pp. 398, $3.75.

Positivism—A Study in Human Understanding, by Richard von Mises, Cambridge, Massachusetts: Harvard University Press (1951), pp. 404, $6.

Primer of Intellectual Freedom, by Howard Mumford Jones, Cambridge, Mass.: Harvard University Press (1949), pp. 191, $2.75.

Progress in Cosmic Ray Physics, edited by J. G. Wilson, New York: Interscience Publishers (1952), pp. 557.

Science and the Church

(*Continued from page 146*)

This notwithstanding, it is worthy of note that modern scholars in these fields regard the idea of the creation of the universe as entirely compatible with their scientific conceptions, and that they are even led spontaneously to this conclusion by their scientific research. Only a few decades ago, any such "hypothesis" was rejected as entirely irreconcilable with the present state of science. As late as 1911, the celebrated physicist Svante Arrehnius declared that "the opinion that something can come from nothing is at variance with the present-day state of science, according to which matter is immutable." (*Die Vorstellung vom Weltgebäude im Wandel der Zeiten,* 1911, p. 362). In the same vein we find the statement of Plate: "Matter exists. Nothing can come from nothing; hence matter is eternal. We cannot admit the creation of matter." (*Ultramontane Weltanschauung und Moderne Lebenskunde* [1907], p. 55.)

On the other hand, how different and much more faithful a reflection of limitless visions is the language of an outstanding modern scientist, Sir Edmund Whittaker, a member of the Pontifical Academy, when he speaks of the above-mentioned inquiries into the age of the world:

> These different estimates converge to the conclusion that there was an epoch, 10^9 or 10^{10} years ago, on the further side of which the cosmos, if it existed at all, existed in some form totally unlike anything known to us: so that it represents the ultimate limit of science. We may perhaps without impropriety refer to it as the Creation. It supplies a concordant background to the view of the world which is suggested by the geological evidence, that every organism ever existent on the earth has had a beginning in time. If this result should be confirmed by later researches, it may well come to be regarded as the most momentous discovery of the age; for it represents a momentous change in the scientific conception of the universe, such as was effected four centuries ago by the work of Copernicus (*Space and Spirit* [1946], pp. 118–19).

CONCLUSION

What, then, is the importance of modern science for the argument for the existence of God based on the mutability of the cosmos? By means of exact and detailed research into the macrocosm and the microcosm, it has considerably broadened and deepened the empirical foundation on which this argument rests, and from which it concludes to the existence of an *Ens a se,* immutable by His very nature. It has, besides, followed the course and the direction of cosmic developments, and, just as it was able to get a glimpse of the term toward which these developments were inexorably leading, so also has it pointed to their beginning in time some five billion years ago. Thus, with that concreteness which is characteristic of physical proofs, it has confirmed the contingency of the universe and also the well-founded deduction as to the epoch when the cosmos came forth from the Hands of the Creator. . . .

Usborne: Federalists in Europe

(*Continued from page 158*)

them. The fact that the Scots and the English fought bitter wars against one another from the beginning of their respective histories till the eighteenth century had nothing to do with their temperament, their integrity, or their policies. It happened because they were separate and sovereign. In 1707 they ceased to be so. And the wars ceased.

Similarly in the world. Britain and Germany, America and Russia, China and Japan, even India and Pakistan, all can go to war for the same single reason. They have, or have had, the armed forces with which to do so. Such a senseless state of affairs ought no longer to be tolerated. A world federal parliament should be set up capable of taking their arms away from them. It's as simple as that. But will such idealism ever be achieved? Who can tell? Certainly not, if it is never advocated. Moreover, the value of taking the extreme position is that it makes all others seem mild and easy by comparison.

News and Notes

Prepared by Peter Axel

U.S. Atomic Energy Developments

Declassification.—The governments of the United States, the United Kingdom, and Canada announced the annual revision in the *Declassification Guide* on April 7. The principal revisions will release data on the nuclear properties of uranium and data necessary for low-power reactor design. The information also included the thermal neutron cross section of plutonium-239 as well as the thermal fission yield of neutrons, 3 neutrons per fission. The value of another thermal neutron cross section, the exceptionally large one of Xe–135, was also revealed.

(This recalls one of the incidents in the Great Secret story. In 1946 the Los Alamos laboratory recalled the nuclear data charts that it had sent out and which had been posted at all universities throughout the country because they included this cross section, and returned them after eliminating the figure.)

Secrecy Criticism from Within.—Gordon Dean, AEC chairman, announced on April 1 that he wanted to tell the public more about the tests at Eniwetok but that so far he had encountered opposition from the military.

Mr. Dean said: "I don't think you can plan intelligently for civilian defense by talking about the effects of so-called 'nominal bombs' such as those dropped on Hiroshima and Nagasaki and then trying to extrapolate on the effects of bombs of different energy.

"I've been strong for declaring the energy release of the bomb used to test effects upon a structure at Eniwetok last year, but so far I have had opposition from military circles.

"The military feel that it would give significant military information to the Russians," Mr. Dean explained, but he did not think it was "sensitive information."

Bomb Tests.—Millions of Americans viewed the explosion of a powerful atomic bomb as television, radio, newsreels, and newspapers focussed attention on the first "public" A-bomb test in Nevada, on April 22. The observers were from between ten and eleven miles from the explosion. Mr. Gordon Dean, chairman of the AEC, said, "It is planned to give a slightly larger energy release than the bombs exploded at Hiroshima, Nagasaki, and Bikini." He also indicated that larger bombs had been tested at Eniwetok.

The troops participating in this test were drawn from widely scattered military units so that the men could afterwards inform their units about atomic weapons. The men were in foxholes and trenches four and one-half to five feet deep, some of which were sandbagged. The soldiers crouched double in their entrenchments with their backs to the sky. Immediately after the great fireball filled the sky, the men climbed out of their trenches and stood in the open as the shock wave, driving great clouds of dust, swept past them. Hanson Baldwin, military expert of the *New York Times* reported that the troops were from six to seven miles from the explosion point; William L. Laurence, the science reporter of the same newspaper, gave the figure as four miles.

Although the bomb was exploded high in the air, at between 3,000 and 3,500 feet, the troops waited one and one-half hours while the radiological detection teams were checking the area for contamination before they proceeded into the area above which the bomb was exploded. The target was designated by a series of concentric rings and was supposed to designate an enemy strongpoint in the field.

This bomb was the fifteenth "nuclear detonation" within continental United States. There had been two other nuclear tests in April, both of which seemed to involve considerably less destructive devices.

As could be expected, the psychological results of the "public" tests were once again to create, in the press and in public opinion, the feeling of a "letdown," reminiscent of that following the Bikini tests. As expected from the theory of the atomic blast, and from observations in Hiroshima and Nagasaki, simple trenches were found to provide satisfactory protection at a distance of two or three miles from ground zero. The *U.S. News and World Report*, in an article, "Real Story of Atomic Tests," said that the A-bomb is just a more powerful substitute for an artillery shell, unlikely to be decisive in land warfare. Also the article said, the A-bomb "isn't the city-buster once thought." One of them could not destroy a whole American city. As if the effects of an atomic bomb on an American city had not been analyzed in detail and presented to the public in authoritative statements long ago!

Reactors.—The operation of the Materials Testing Reactor at Arco, Idaho, reactor site was announced on April 4. The reactor became "critical" on March 31 and is gradually being brought to full power by the operating contractor, Phillips Petroleum Company of Oklahoma. The necessary research and development work was done by the Argonne and Oak Ridge laboratories, the engineering design by the Blaw Knox Construction Company of Pittsburgh, and the Fluor Corporation of Los Angeles was the major construction contractor.

The total cost of the reactor was within the original estimate of $18 million. It will be used to determine the effects of intense radiation on materials which might be used in future reactors, particularly power reactors.

Industrial Participation.—The AEC has begun negotiations with the Dow Chemical Company and Detroit Edison Company for a one-year continuation of the Dow-Edison study of greater industrial participation in developing nuclear reactors. The Dow-Edison continuation proposal calls for spending $250,000 in this research area. Work on the same problems to be done by the Commission, much of which is already underway or scheduled, may cost as much as $750,000.

In its announcement the AEC said that the four study groups (of which Dow-Edison is one) have all submitted interim reports which show a cautious optimism that the difficult technical and cost factors will be solved eventually. The Dow-Edison group is the only one of the four that has made a specific proposal for additional research and development work by both the companies and the AEC laboratories. These additional studies would involve both reactors and chemical separation processes but would not include a final reactor design.

The AEC has said that it was ready to consider proposals from other industry groups that would like to make preliminary one-year studies of the subject.

On May 1, the Commisson announced the establishment at its Washington headquarters of a new Office of Industrial Development to aid in the administration of the industrial participation program. Dr. William Lee Davidson, formerly director of physical research for the B.F. Goodrich Company in Akron, Ohio, will head the office.

Additional Expansion.—The quest for a new gaseous diffusion plant was an-

nounced by General Manager M.W. Boyer on April 11. The Commission is looking for 5,000 to 6,000 acres near a source of power and water. At present the studies are being concentrated in the Ohio River Valley.

Preliminary designs call for a $1 billion plant which will employ 4,000 to 5,000 regular workers and use 1.8 billion kilowatts of power.

The construction is estimated to last three-and-a-half to four years. There would only be one year in which the construction force would exceed 17,000 workers; during one two-months period there will be a peak demand for about 34,000 workers. Interim power requirements during the construction of the permanent power facilities would be 400,000 kilowatts.

Personnel.—THOMAS E. MURRAY has been nominated for reappointment to his post as a Atomic Energy Commission member by President Truman. The appointment, if approved by Congress, will last for five years beginning June 30.

MR. WALTER J. WILLIAMS, deputy general manager, will assume, in addition to his present duties, those of assistant general manager for manufacturing. The latter position has been vacant since February 29, when Major General Thomas F. Farrell resigned. Mr. JAMES L. KELEHAN was promoted to the place of assistant to Mr. Williams in both his functions.

CLARENCE L. KARL was appointed manager of the AEC's Fernald (Ohio) Area to replace James F. Chandler who is rejoining the U.S. Corps of Engineers. The Fernald Area supervises the construction and operation of the new Feed Materials Production Center nineteen miles northwest of Cincinnati.

DR. J. PERRY MORGAN, who formerly was chief of the staff, Technical Branch of New York Operations Office, has become manager of the AEC's St. Louis (Mo.) Area, filling the post vacated by Mr. Karl.

DR. SAMUEL COLVILLE LIND, of the Oak Ridge National Laboratory, has been awarded the Priestly Medal—The American Chemical Society's highest honor—for his "outstanding services to chemistry." Dr. Lind is acting director of the laboratory's chemistry division and also is a director of the Oak Ridge Institute of Nuclear Studies. Dr. Lind, formerly head of the Department of Chemistry at the University of Minnesota, carried out extensive studies of the effect of radiation on chemical reactions long before the subject became fashionable after the advent of the atomic bomb.

Defense Department Appointments.—Dr. Robert F. Bacher, head of the Committee on Atomic Energy, Research and Development Board, Department of Defense, announced the appointment of two new committee members. They are DR. HANS A. BETHE, professor of Physics, Cornell University and MR. WINNE, vice-president in charge of engineering policy, General Electric Company, Schenectady.

Uranium Bonus

More than $250,000 dollars were paid out in 1951 as bonuses to uranium ore producers by the Atomic Energy Commission. The bonus is offered to new producers and certain existing producers on that part of the first five tons of acceptable uranium oxide ore delivered to qualified stations between March 1, 1951, and February 28, 1954. The money is paid directly to the producers and is in addition to the established price.

This bonus should not be confused with the $10,000 premium available for the discovery and production of high-grade uranium ores from new domestic deposits. No one has yet qualified for this bonus which has been offered since 1948.

U. N. Disarmament Commission

The United States was victorious in a parliamentary maneuver to have the U.N. Disarmament Commission discuss the disarmament plans of the U.S. and the USSR separately. On April 2, the Commission formed two separate committees. "Committee One" will examine the U.S. proposal for a global census of arms and armed forces, including verification, as the first step in a disarmament program. "Committee Two" will consider the prohibition of atomic weapons and the immediate arms reduction demanded by the Soviet Union. Both committees are composed of the eleven members of the Security Council plus Canada.

The early meetings held by the Disarmament Commission have not produced any signs of a possible agreement or compromise between the two proposals.

National Science Foundation

Appropriations.—On May 28, as this issue was going to press, the Senate Appropriations Committee reported its recommendation for the National Science Foundation. The Senate Committee figure was $5 million, only $1.5 million above the sum recommended by the House, and $10 million *below* the amount requested by the President. The bill now goes to the Senate floor, but it is considered unlikely that the figure will be raised.

Divisional committees which will advise the National Science Foundation on its activities were announced on March 11. The Committee for Mathematical, Physical, and Engineering Sciences includes: Dr. A. Adrian Albert, Mathematics, University of Chicago; Professor Jesse W. Beams, Physics, University of Virginia; Dr. William L. Everitt, Engineering, University of Illinois; Dr. Leo Goldberg, Astronomy, University of Michigan; Professor Morrough P. O'Brien, Engineering, University of California; Dr. George B. Pegram, Physics, Columbia University; Professor Charles C. Price, Chemistry, University of Notre Dame; Mr. William W. Rubey, Geology, U.S. Geological Survey; Dr. Cyril Stanley Smith, Physics, University of Chicago; Professor Samuel S. Wilks, Mathematics,

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The Education of the Public in Science, by I. Bernard Cohen *Harvard University*

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Princeton University; and Professor E. Bright Wilson Jr., Chemistry, Harvard University.

The Committee for Biological Sciences includes: Dr. Marston Bates, the Rockefeller Foundation; Dr. George W. Beadle, California Institute of Technology; Professor Donald R. Costello, University of North Carolina; Professor Wallace O. Fenn, University of Rochester; Dr. Jackson Foster, University of Texas; Dr. Theodor Just, Chicago Natural History Museum; Professor John S. Nicholas, Yale University; Dr. Hubert B. Vickery, Connecticut Agricutural Experiment Station; and Dr. Douglas M. Whitaker, Stanford University

Fellowships.—The National Science Foundation awarded 624 graduate fellowships for the academic year 1952–53. Compared with other federal fellowship programs, a greater proportion of NSF awards (169, or 27 per cent) went to first-year graduate students. Second-year students were awarded 170 fellowships, 230 went to more advanced predoctoral students, and 55 to postdoctoral candidates. In each category the awards represented a selection of about 20 per cent of the fellowship applicants.

The fields of biological sciences, chemistry, and physics accounted for 158,140, and 137 of the fellowships, respectively.

In addition, 75 fellowships were awarded in engineering, 62 in mathematics, and 36 in the earth sciences; 16 fellowships were distributed in the fields of agriculture, anthropology, and astronomy.

Appointment.—Dr Raymond John Seeger, formerly chief of the Aeroballistics Research Department of Ordnance Laboratory, has been appointed to the staff of the Division of Mathematical, Physical, and Engineering Sciences.

New Officers of Federation of American Scientists

Jules Halpern (physics, University of Pennsylvania) was elected FAS chairman, and Victor F. Weisskopf (physics, M.I.T.) was chosen vice-chairman. Eleven additional members were elected to the governing body, the Council, by the members-at-large of the organization. These delegates-at-large are: Judith Bregman, chemistry, M.I.T.; Charles D. Coryell, chemistry, M.I.T.; Lloyd H. Donnell, mechanics, Illinois Institute of Technology; Paul I. Hartman, physics, Cornell University; David Hawkins, philosophy, University of Colorado; David L. Hill, physics, Vanderbilt University; Edwin C. Kemble, physics, Harvard University; M. S. Livingston, physics, M.I.T.; Robert L. Platzman, physics, Purdue University; Henry C. Torrey, physics, Rutgers University; and Hugh C. Wolfe, physics, Cooper Union.

The FAS Council also contains delegates chosen by FAS chapters (one delegate for each 50 members in each chapter) The eight active chapters of the FAS are Brookhaven, Chicago, University of Illinois, Mohawk (centered at Schenectady, New York), Rochester, Stanford, Washington, D.C., and University of Wisconsin.

Point IV

Budget.—The total request for Point IV (technical assistance to underdeveloped areas) during the next fiscal year is $656 million. This is about 12 per cent of the 5,350 million requested for direct military aid. The largest fraction of this money, $408 million, will be used for Point IV projects in Asia. The Near East and Africa will receive $196 million. American republics are due to receive $22 million, while the remaining $30 million will be used to pay freight charges for relief packages. The 1951–52 budget for Point IV was $418 million. The new budget, if approved by Congress, is expected to add more than 500 technical and professional experts to the 900 that have been working for the program abroad.

New Administrator.—Stanley Andrews was nominated to be administrator of the Technical Cooperation Administration which operates the Point Four program. The nomination was announced by President Truman on April 21, four months after the former administrator, Dr. Henry G. Bennett, died in an airplane crash near Teheran, Iran.

Mr. Andrews took leave of his post as director of the Office of Agricultural Relations in the Department of Agriculture to complete Dr. Bennett's mission.

Linus Pauling Refused Passport

Dr. Linus Pauling, head of the California Institute of Technology's department of chemistry and chemical engineering has revealed that two months ago the State Department refused to issue a passport to him to visit Great Britain. He had been invited to take part in a conference of the Royal Society of London on the structure of proteins and also to speak before the Royal Institution of Great Britain.

This refusal is undoubtedly a result of the McCarran Internal Security Act, which has also hampered strongly the entrance of foreign scientists into the United States for the purpose of attending scientific conferences.

The *Bulletin* intends to devote a major part of its next issue to the examination of the effects of these applications of the McCarran Act to the progress of science.

Sir Henry Tizard's Successor Appointed

The appointment of Professor A. R. Todd, professor of organic chemistry at Cambridge, as chairman of the British government's Advisory Council on Scientific Policy has been announced. Professor Todd is already a member of the Advisory Council on Scientific Policy and succeeds Sir Henry Tizzard as chairman.

The Hiroshima Orphans Fund

As readers of our February issue will remember, welfare agencies in Hiroshima have formed an Hiroshima Peace Center Foundation. In the United States the Reverend Marvin Green of Orange, New Jersey, has formed an associated organization to help the Japanese rebuild their city.

The American branch is called Hiroshima Peace Center Associates, and numerous people are devoting a good deal of unpaid time to help. Among the sponsors are Norman Cousins, Pearl Buck, Bishop G. Bromley Oxnam and others.

When we ran in the February issue a letter from Yoshimaro Mori describing in particular the program of seven orphanages we mentioned the "moral adoption" program.

It is possible for an American to become morally responsible for the care of an Hiroshima orphan by subscribing $2.50 a month. This pays for the orphan's entire support.

So far, readers of the *Bulletin* have sent in $200.00 which we have forwarded to Hiroshima Peace Center Associates. We are very pleased that one article in the *Bulletin* would raise enough to take care of half a dozen Hiroshima orphans for a year. Additional contributions should be sent directly to the Reverend Marvin W. Green, Hiroshima Peace Center Associates, 279 Park Avenue, Orange, New Jersey.

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as reported in TIME MAGAZINE

APRIL 21, 1952

Voice of the Atom

There is one little magazine (circ. 5,600) whose voice is heard around the world. Its name: *Bulletin of the Atomic Scientists*. Its subscribers in 55 countries (including 40 in Russia) read like an international *Who's Who* of statesmen, newscommentators and scientists; many readers consider it a better source of information on the U.S. atomic-energy program than AEC's own reports to Congress.

Last week the *Bulletin* took a look at Russian science. Contrary to popular belief, wrote Editor Eugene Rabinowitch, the quality of science in Russia "is clearly on the upgrade . . . It is wrong to think of contemporary Soviet science as being largely paralyzed by . . . ignorant politicians." In many branches the Russians are turning out brilliant work. Warned the *Bulletin:* The U.S. should beware of "smug satisfaction with our own superiority . . . a belief that we can leave Soviet competition far behind simply by tightening secrecy and preventing leaks."

Penetrating Trickle. The *Bulletin* is quick to print such unpleasant facts or wage a battle for what it considers journalistic or scientific freedom. When the U.S., a year ago, slapped restrictions on the foreign circulation of U.S. technical journals, the *Bulletin* was in the forefront of the fight that got the order repealed. The *Bulletin* is well aware that the Russians read it to try to chart U.S. military and political thinking on the bomb. But Editor Rabinowitch thinks that the U.S. also gains by circulating the magazine in Russia. "It may be but a trickle of fresh water penetrating through the wall," said he, "but even the Russians cannot help being influenced or shaken in their Communist beliefs by what they read from the West."

The explosion of the first A-bombs over Japan led to the founding of the *Bulletin* in 1945. Many scientists, appalled at the destruction, felt that they needed a magazine to help educate the world about the atom bomb. They raised enough money to print 500 copies of a semimonthly newsletter. Rabinowitch, a 51-year-old, Russian-born physical chemist who worked on the Chicago bomb project and now teaches at the University of Illinois, had no trouble finding writers. He has seven Nobel Prizewinners on his editorial board. Scientists like Albert Einstein, Harold C. Urey, Robert Oppenheimer and Leo Szilard write for him for nothing.

Approaching Midnight. The *Bulletin* still loses about $30,000 a year (half its total cost), but its backers are increasing. Last week the Ford Foundation (*see* NATIONAL AFFAIRS) announced that in 1951 it gave the *Bulletin* $25,000. The magazine is careful to print no classified material, has held up an article as long as three years for clearance. Despite this leisurely pace, the editors and contributors think that the world is running out of time in which to work out the international problems of the atom bomb. When the *Bulletin* began, the cover pictured a clock with the hands at eight minutes to midnight. Now the hands have been moved up to three minutes of twelve.

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